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NASA

CONTINUATION OF SPACE SHUTTLE
PROBABILISTIC RISK ASSESSMENT, PHASE 3
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PROBABILISTIC RISK ASSESSMENT

OF THE

SPACE SHUTTLE

A STUDY OF THE POTENTIAL OF
LOSING THE VEHICLE

DURING NOMINAL OPERATION

VOLUME II : INTEGRATED LOSS OF VEHICLE MODEL

PREPARED FOR

US NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

HEADQUARTERS OFFICE OF SPACE FLIGHT (CODE M)

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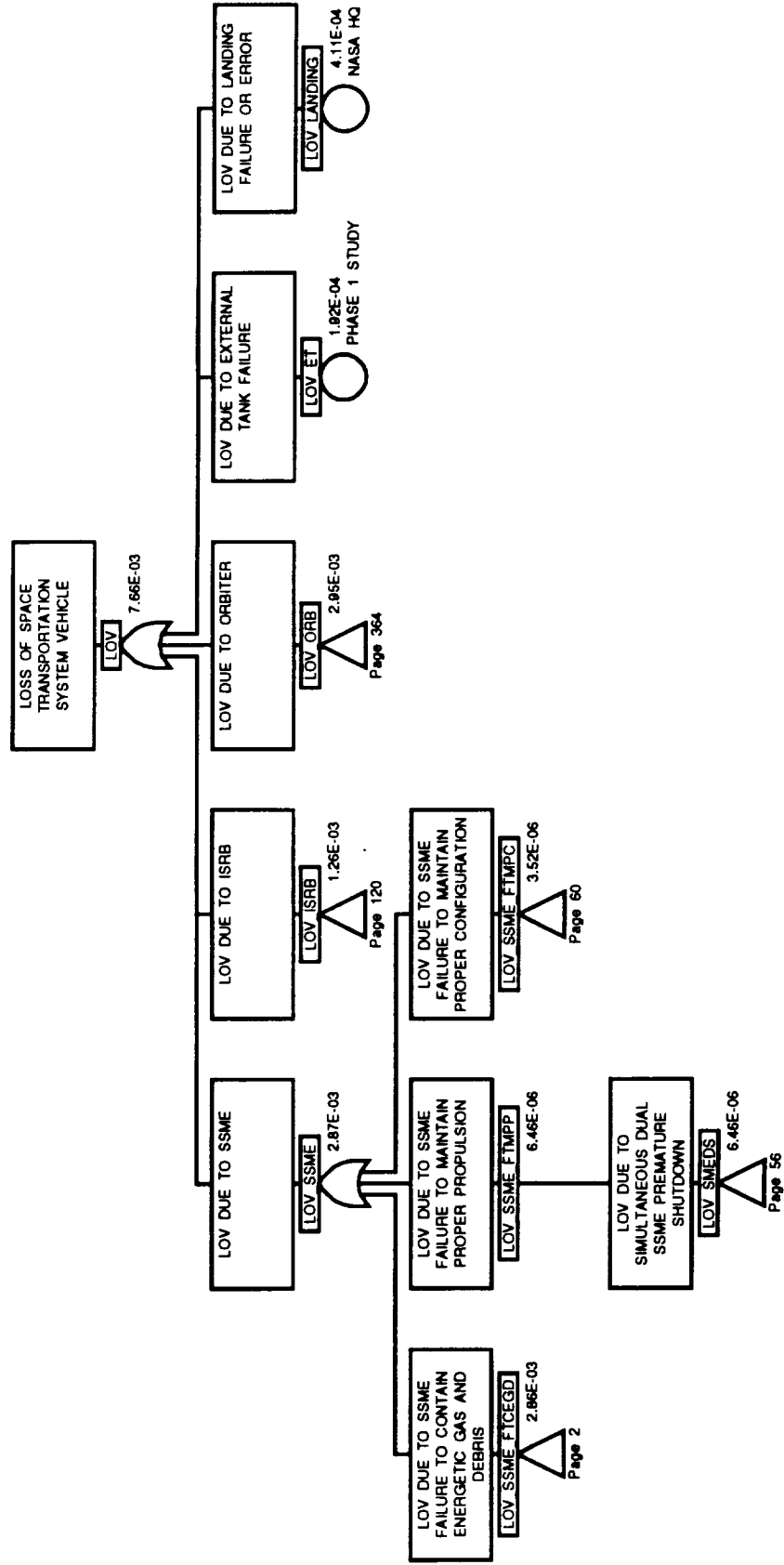
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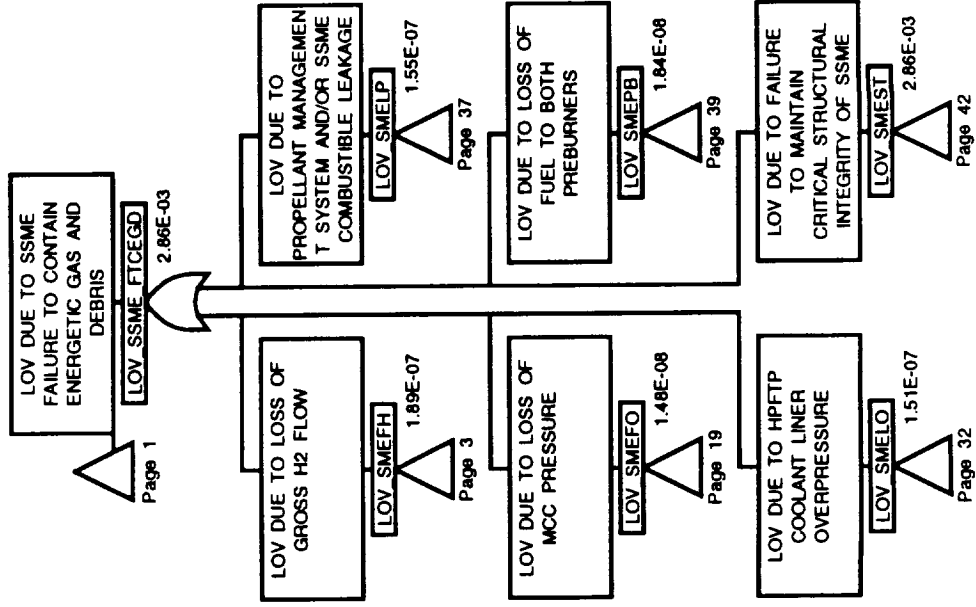
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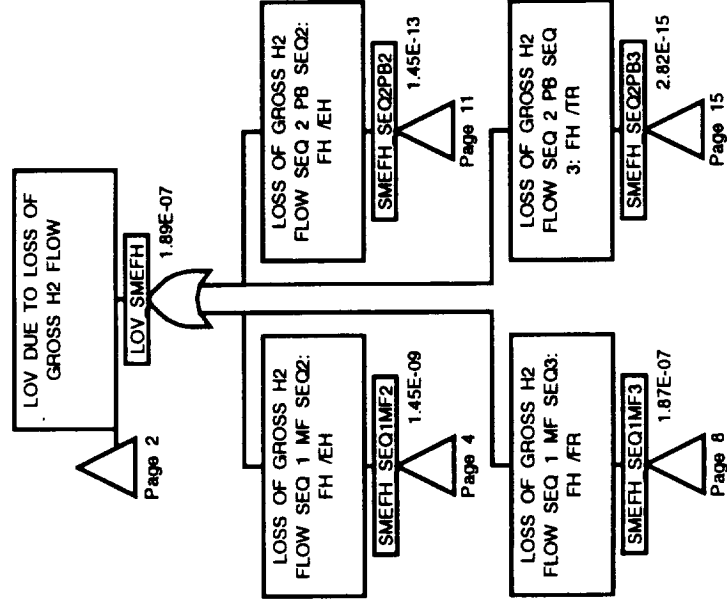
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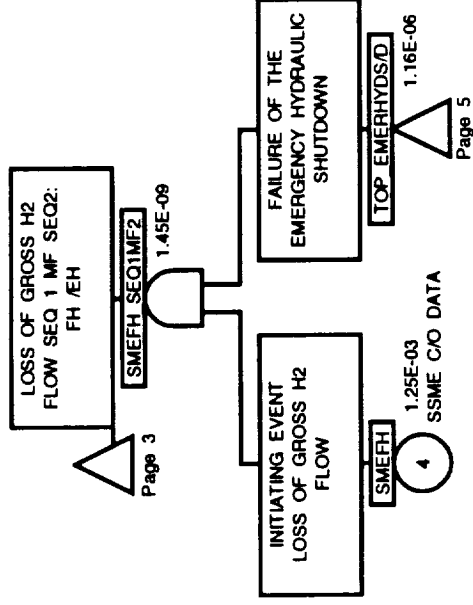
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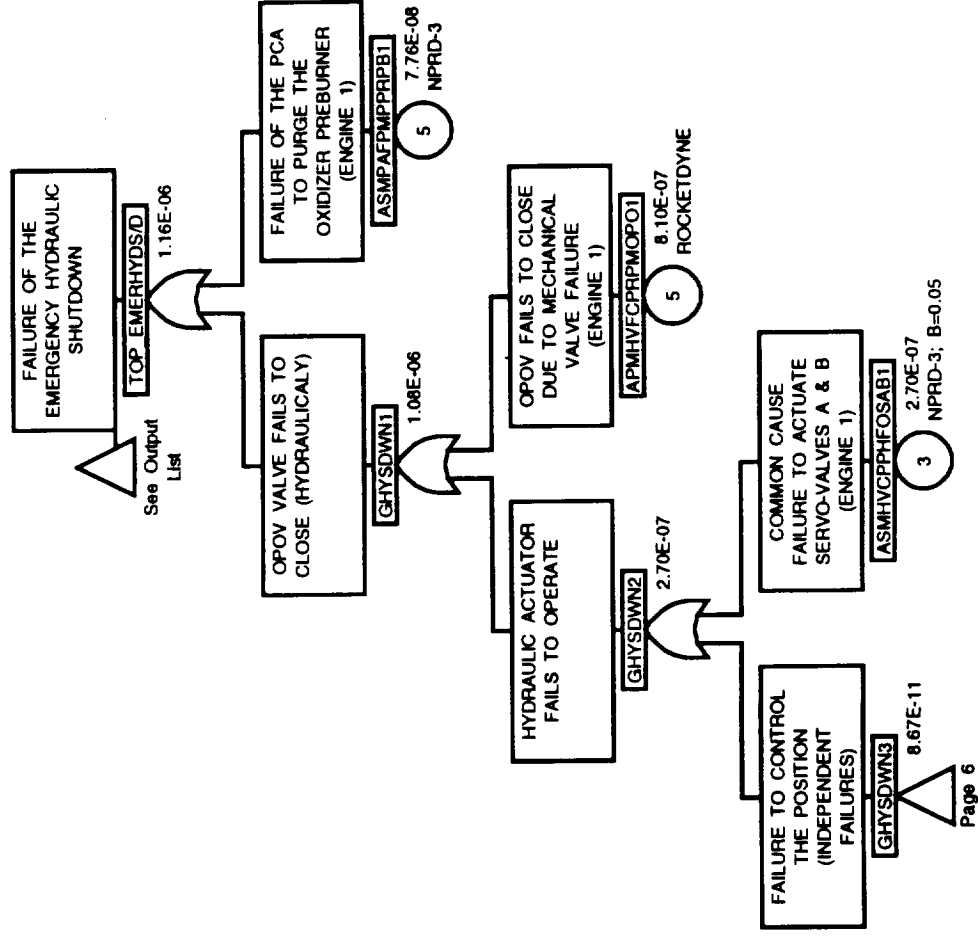


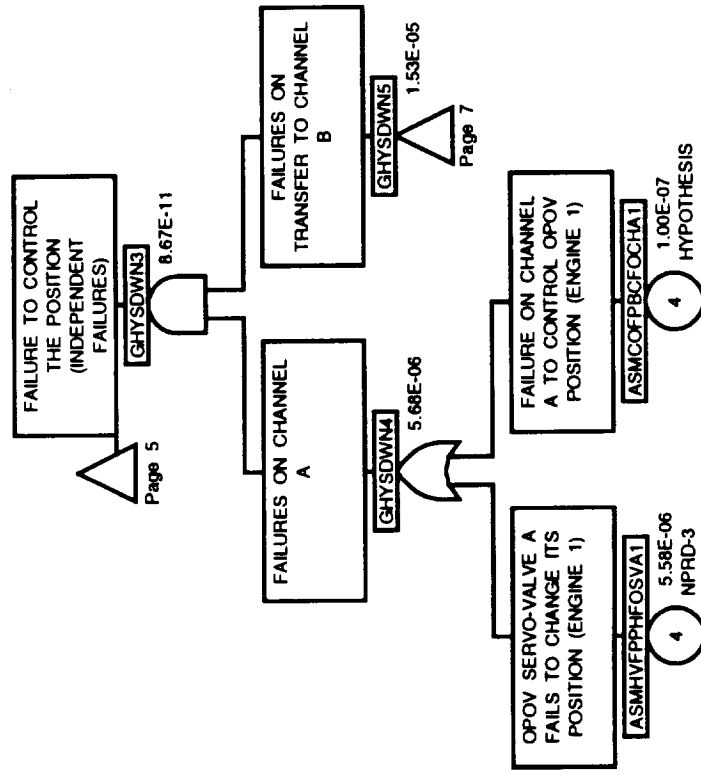


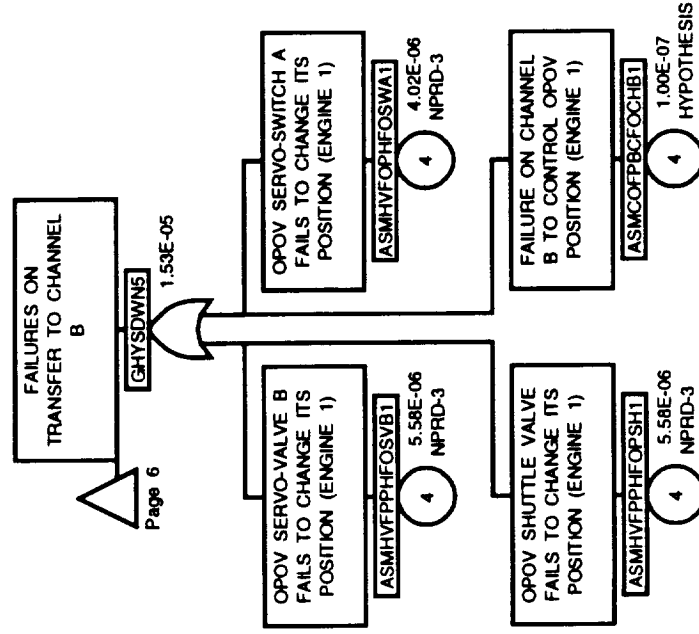
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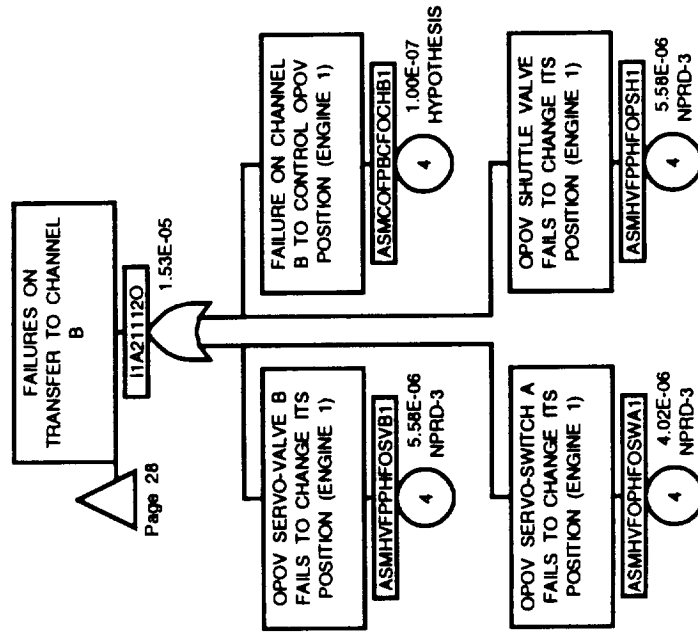
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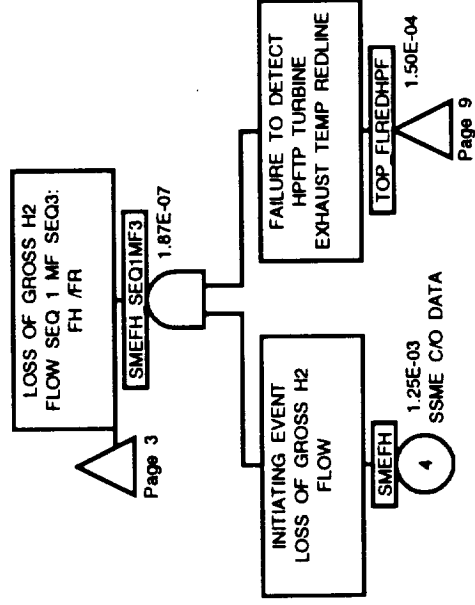


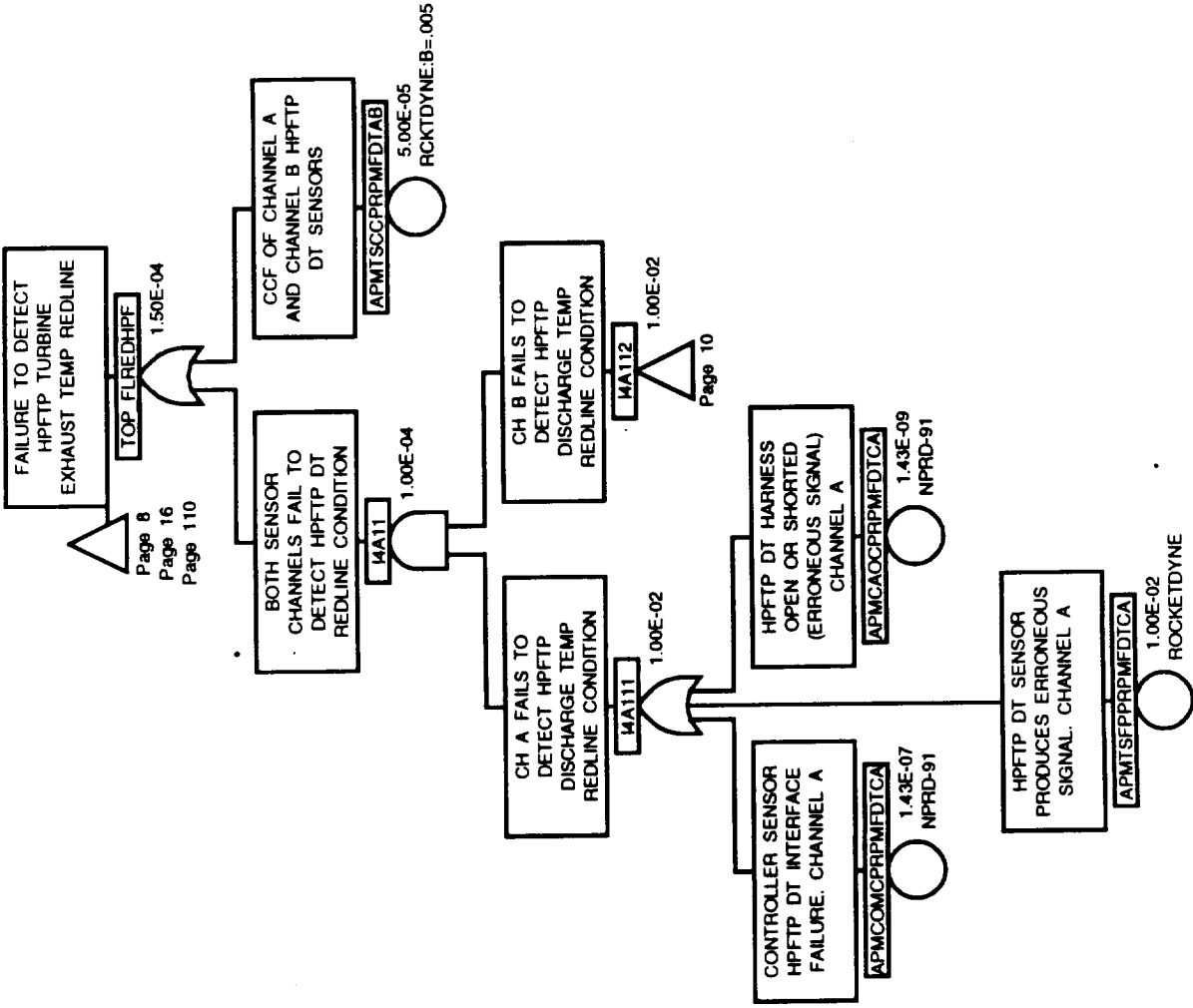


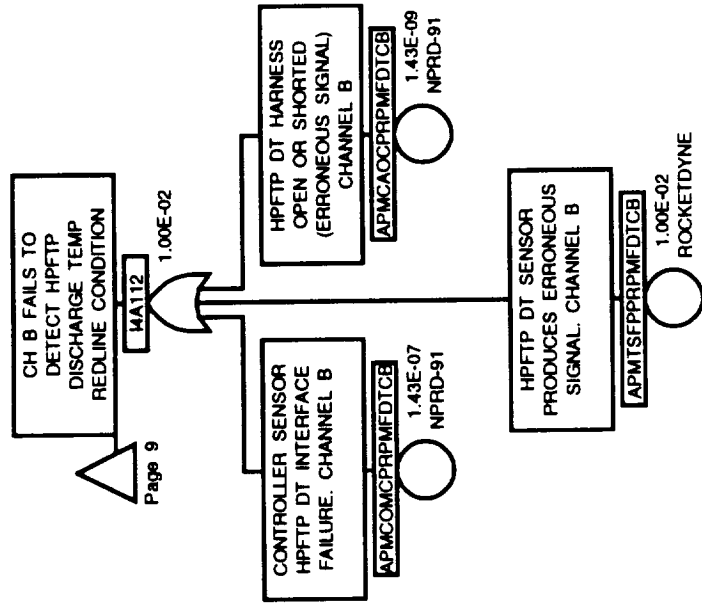
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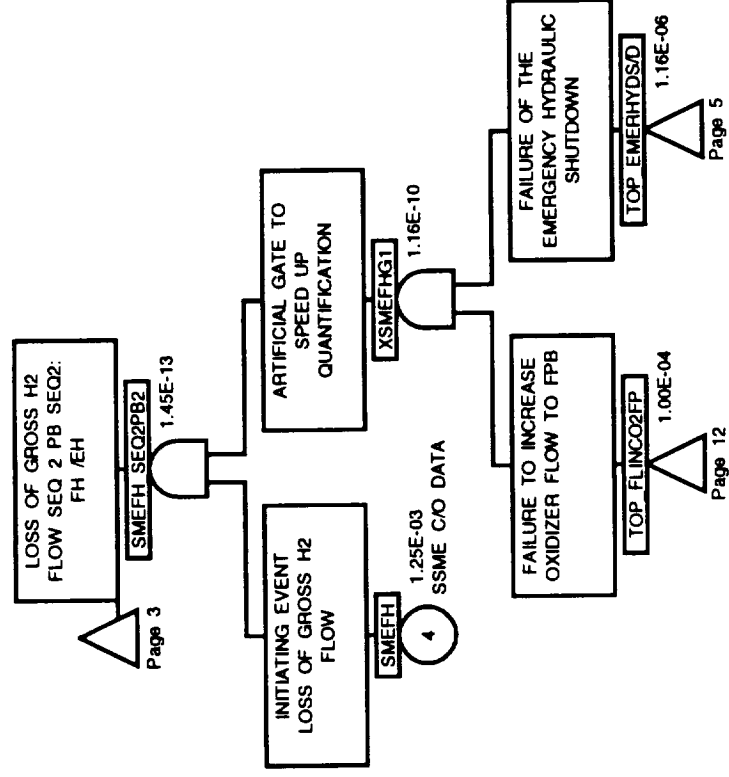


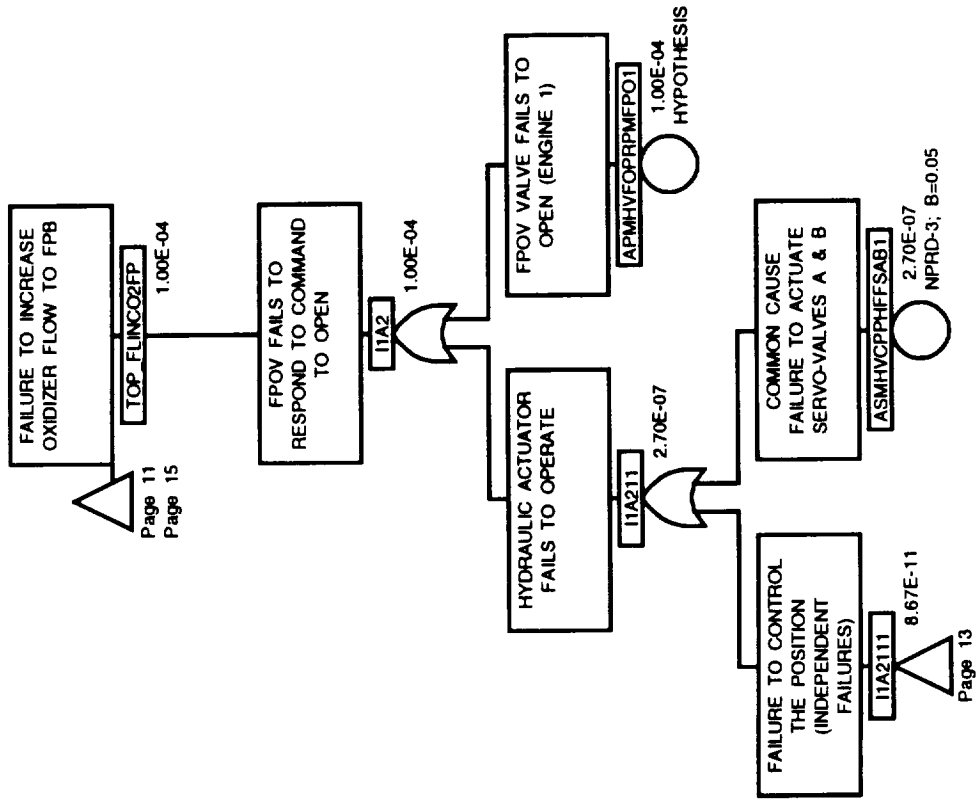
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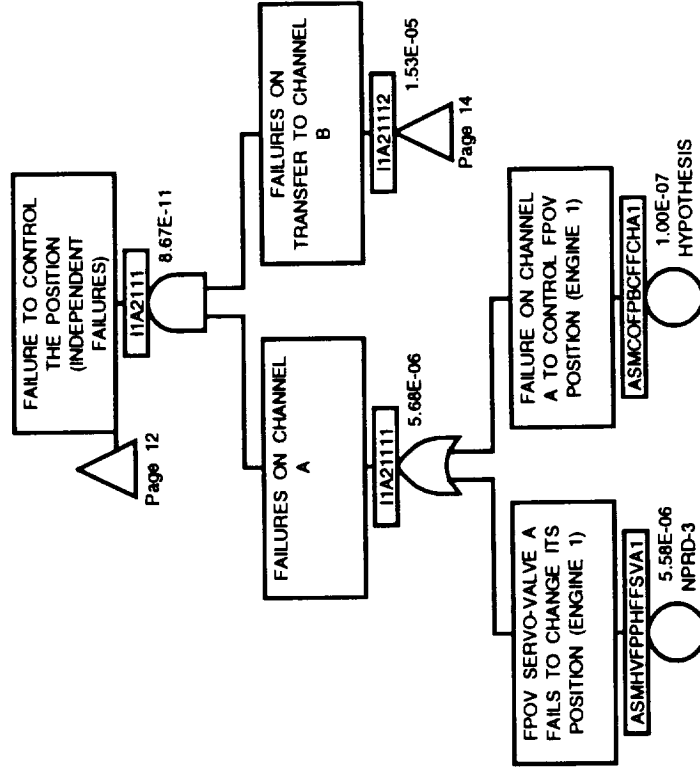


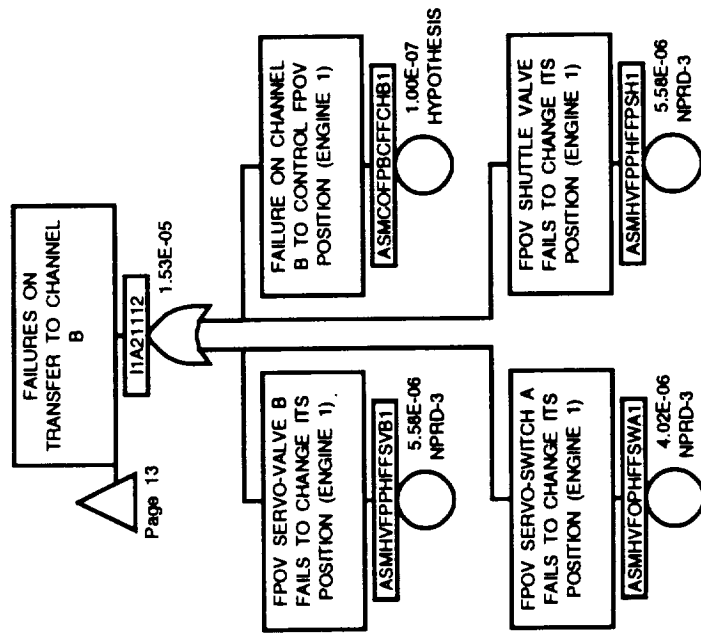




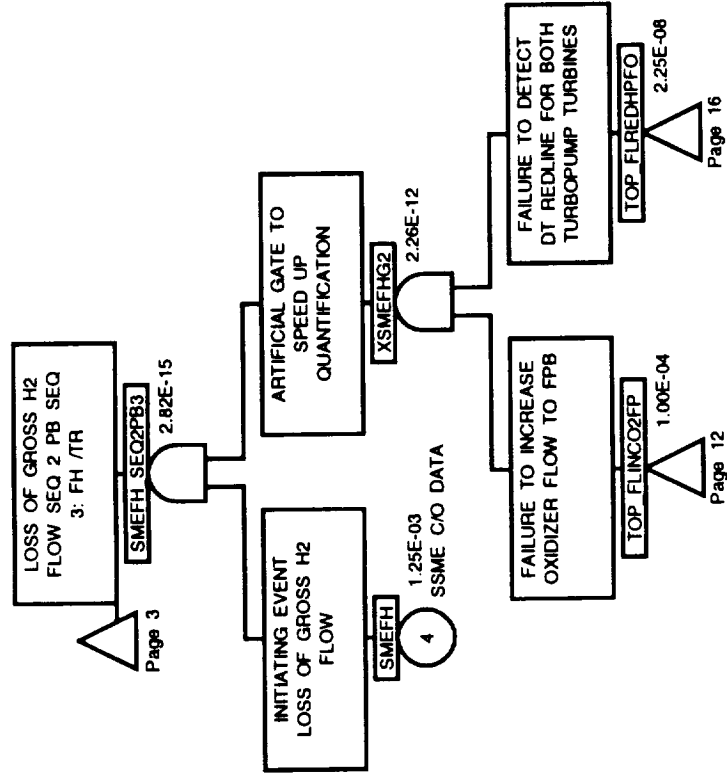


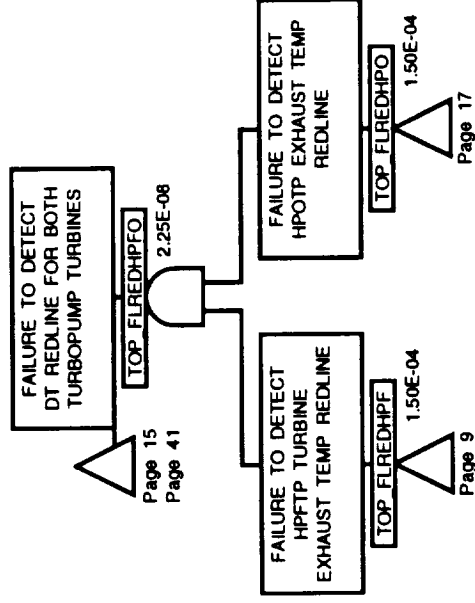


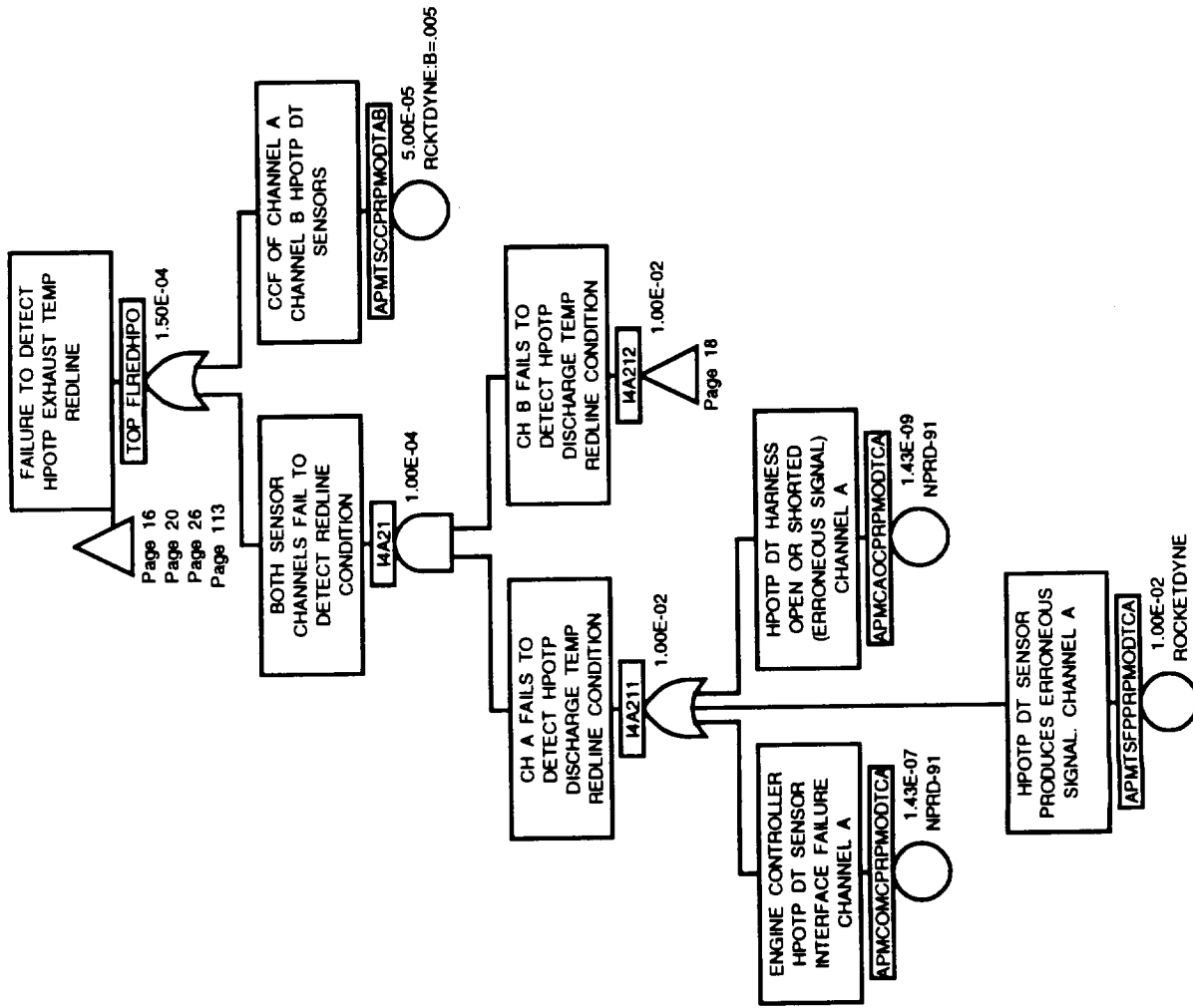


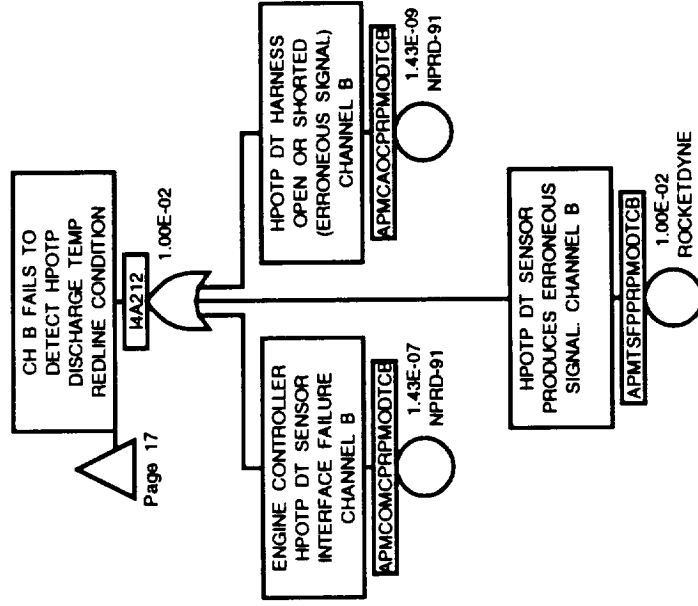


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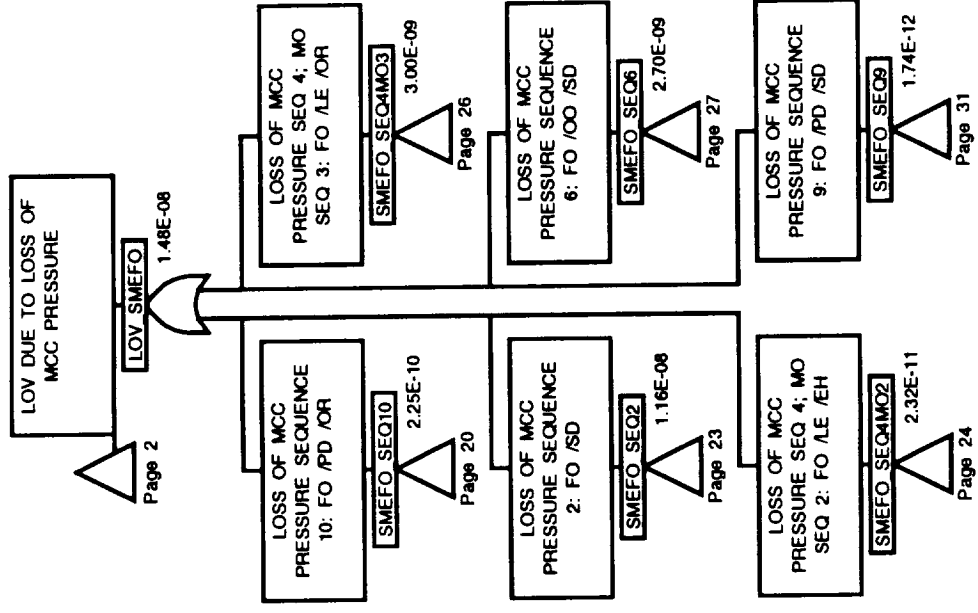


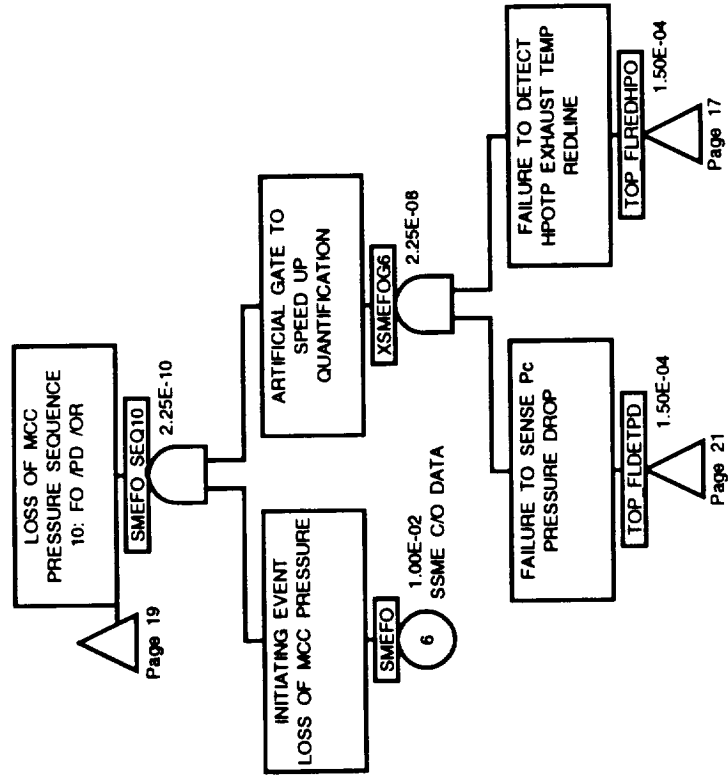


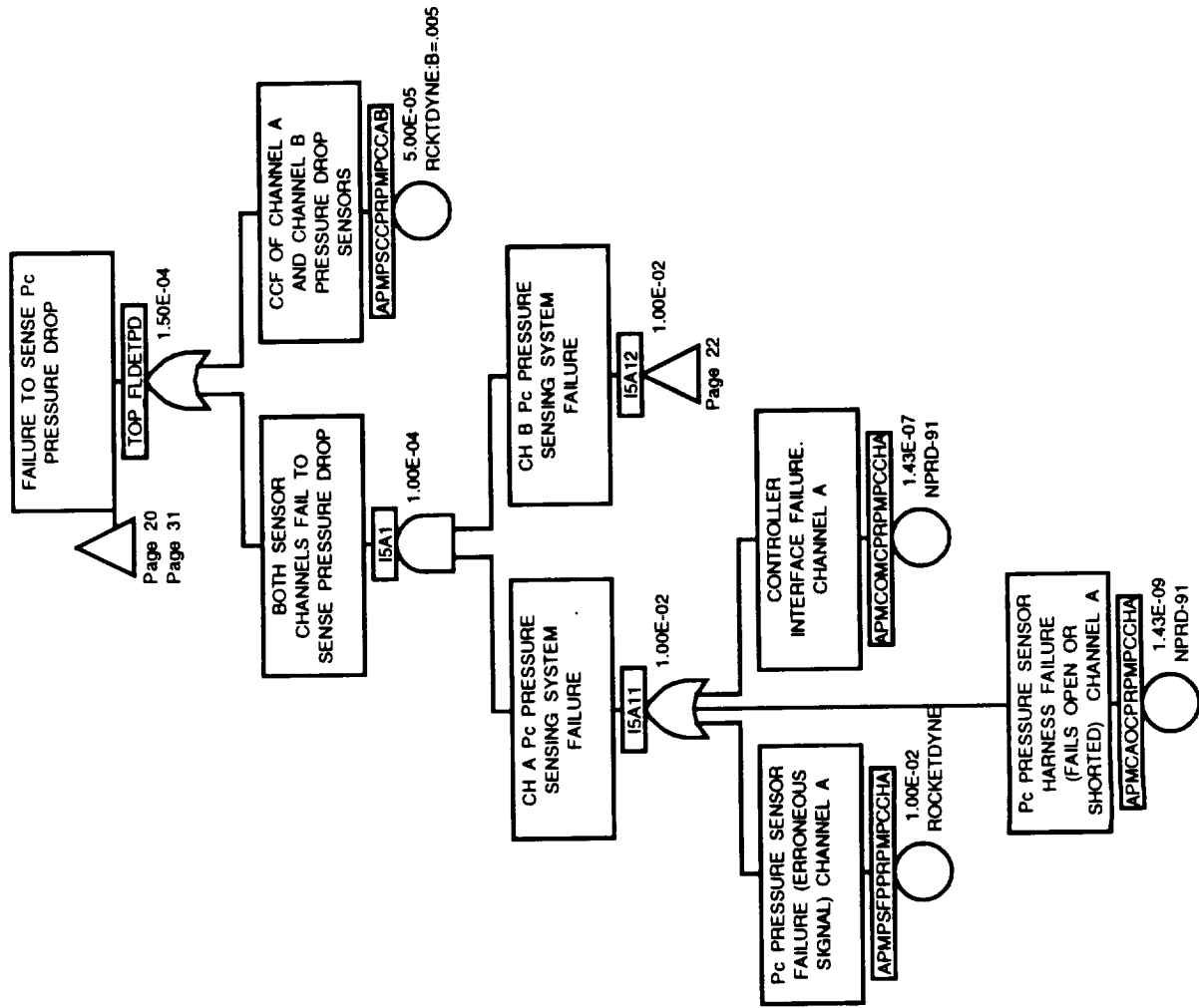


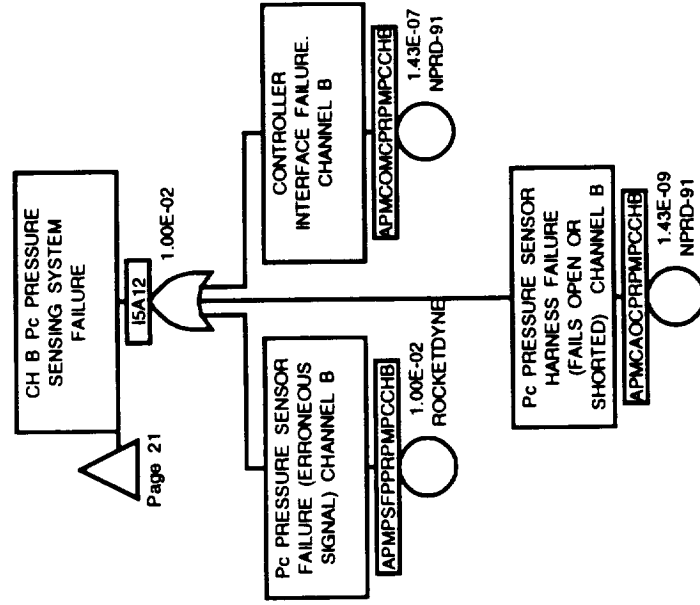


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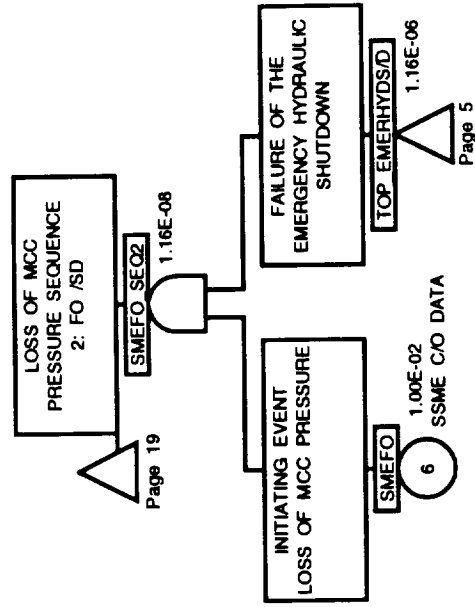


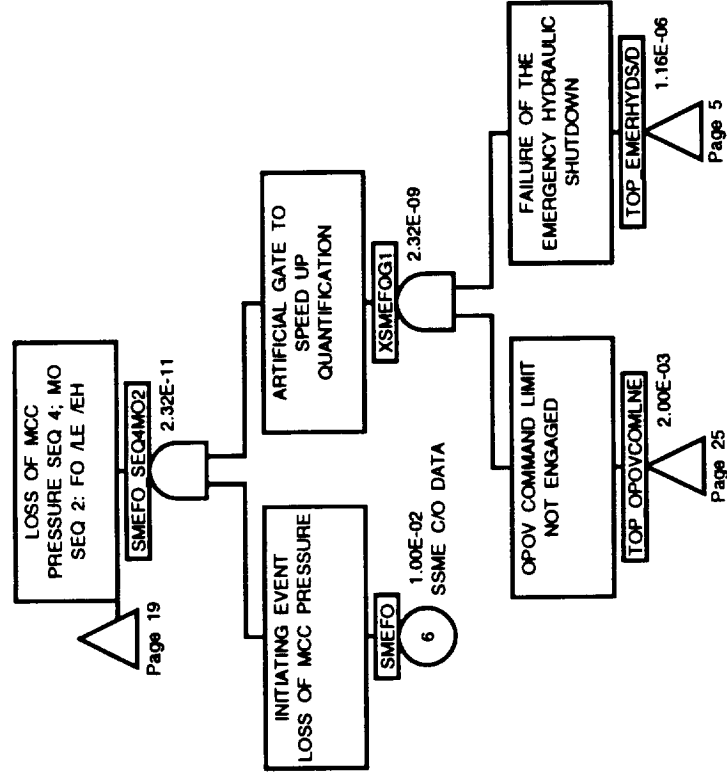


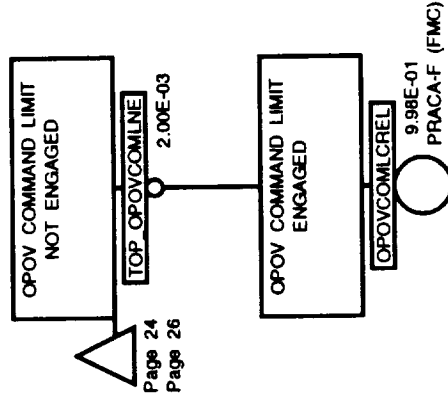




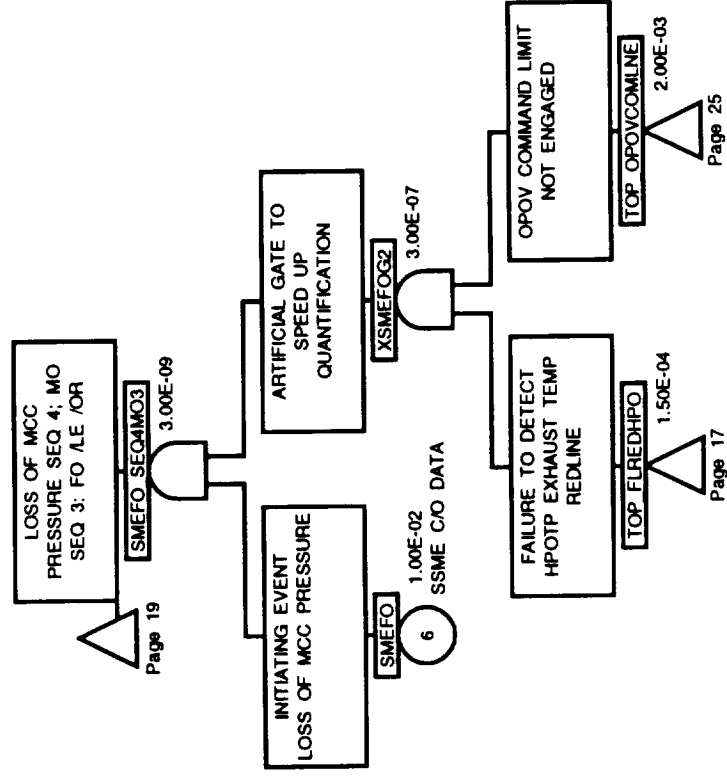
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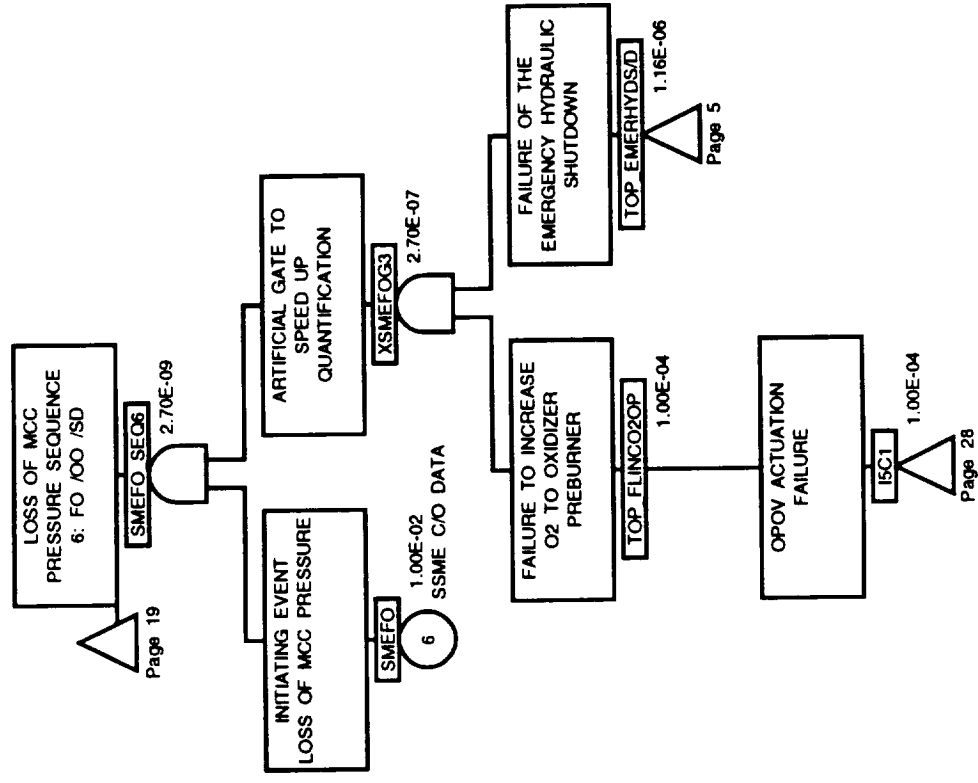






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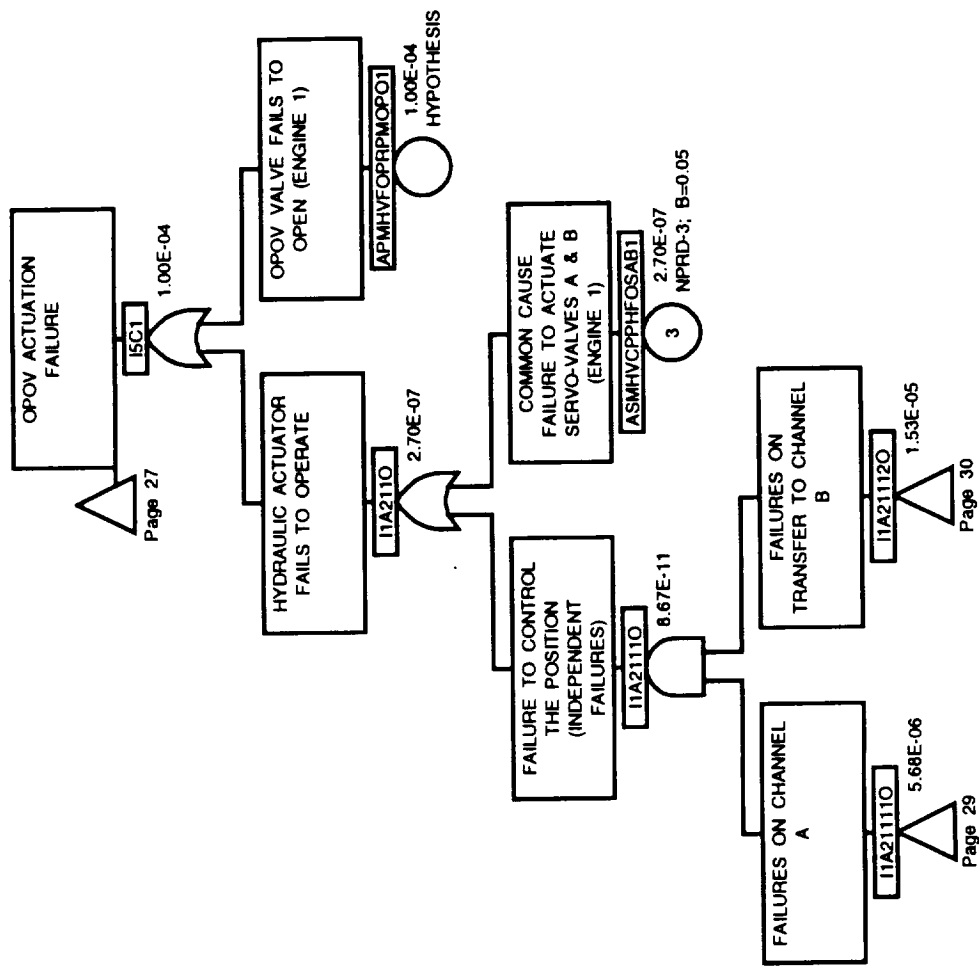


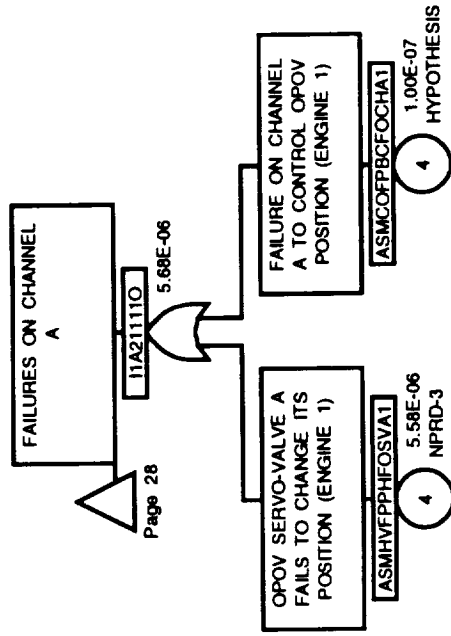


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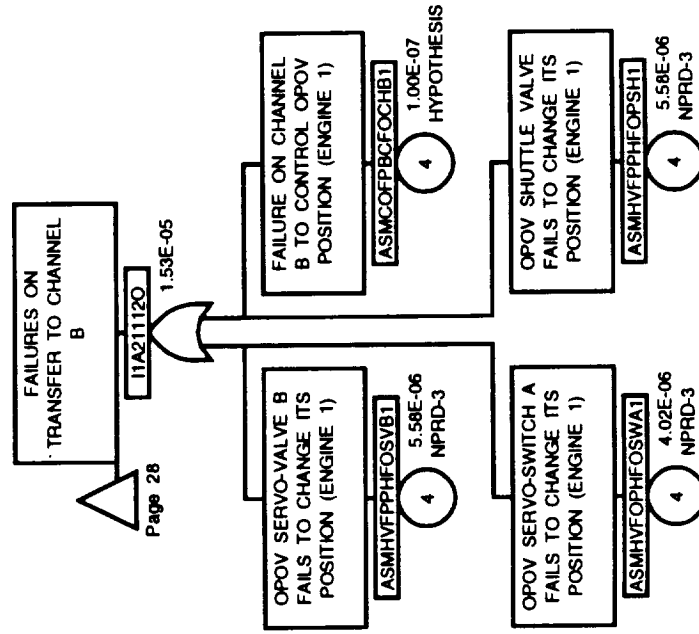
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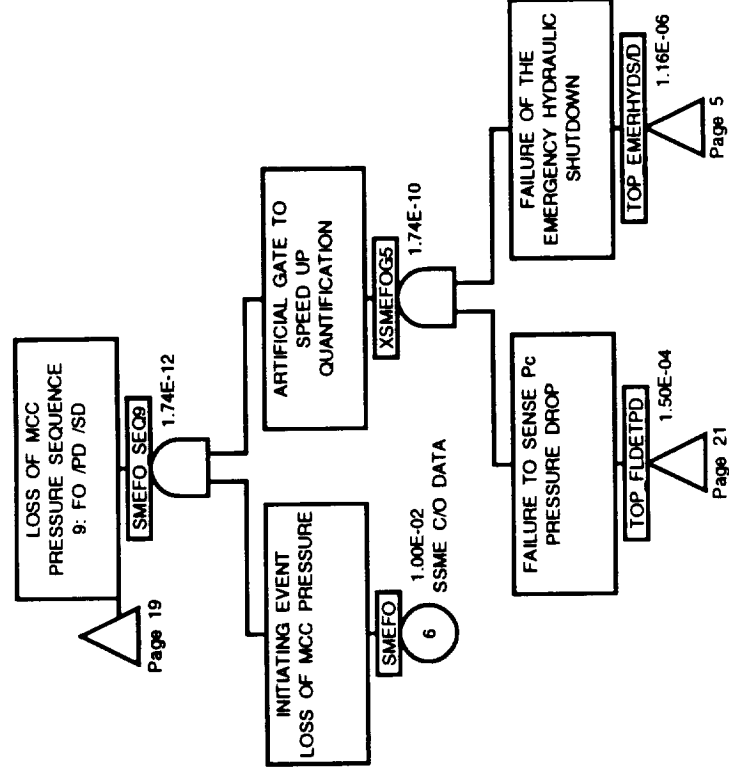


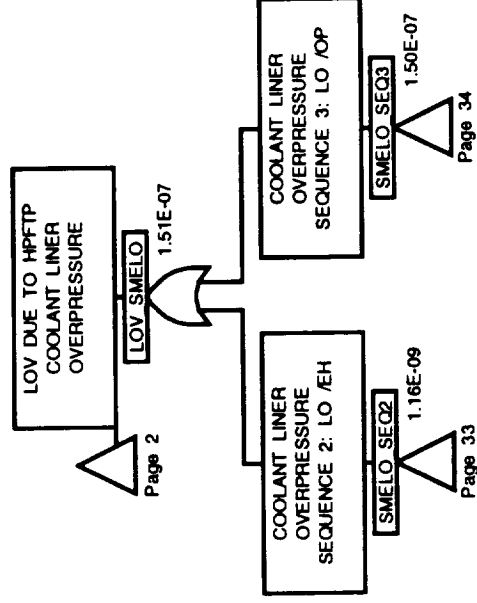


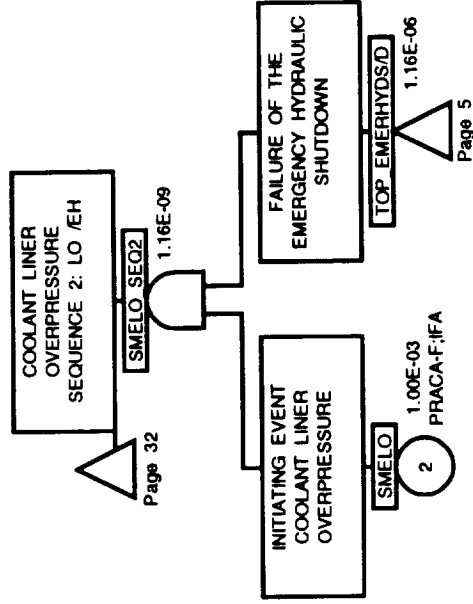
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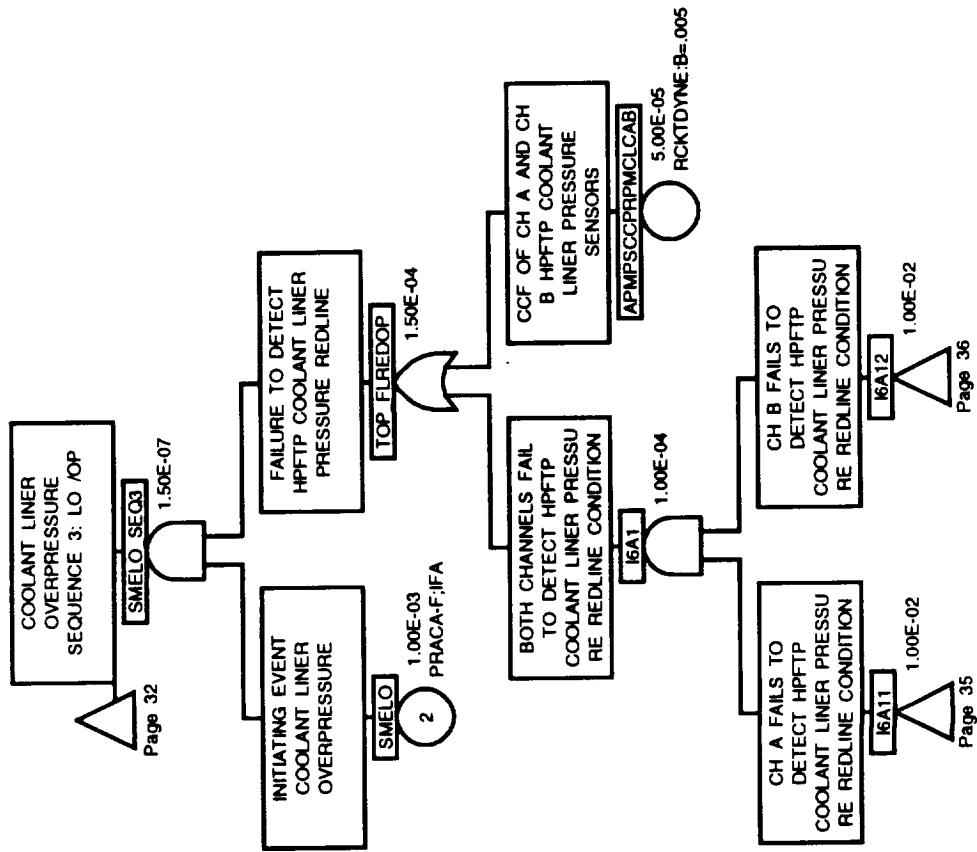


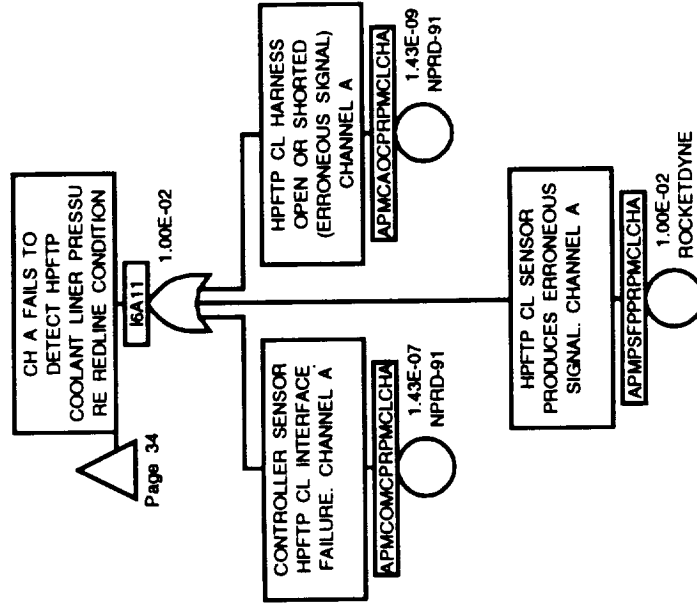
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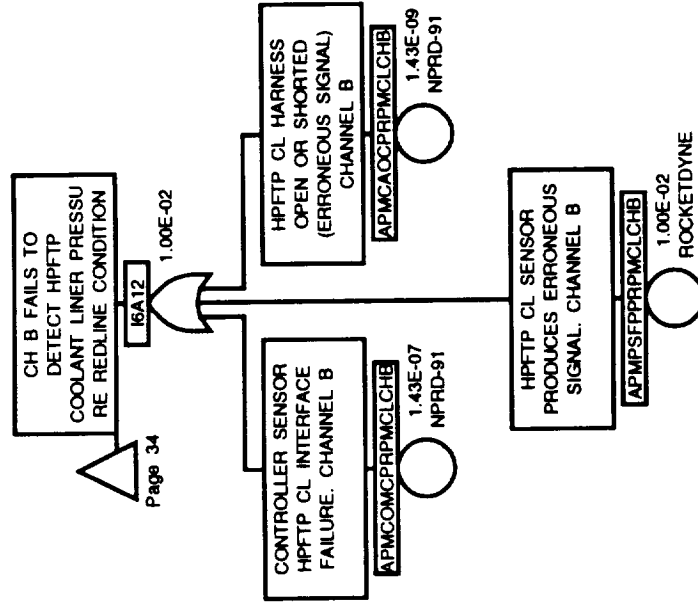




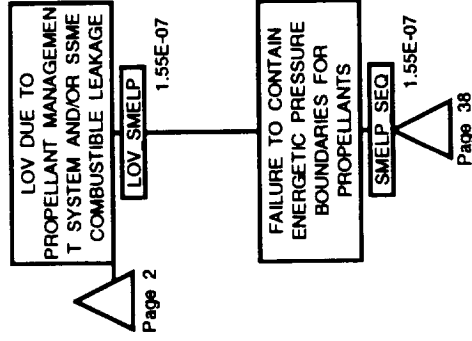


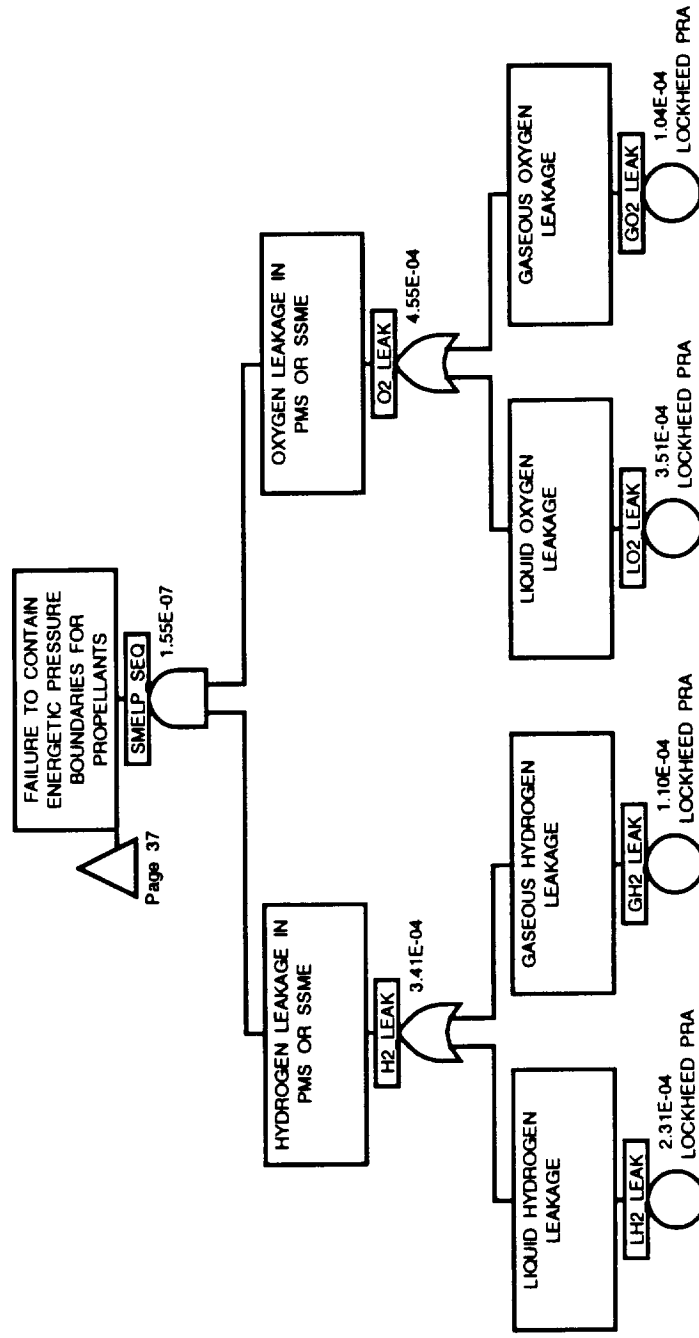


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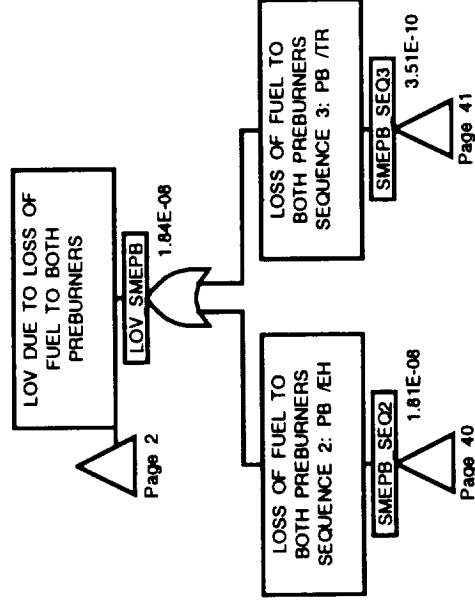


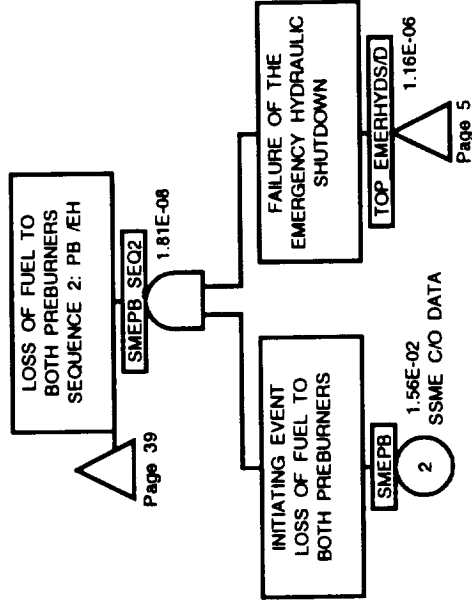
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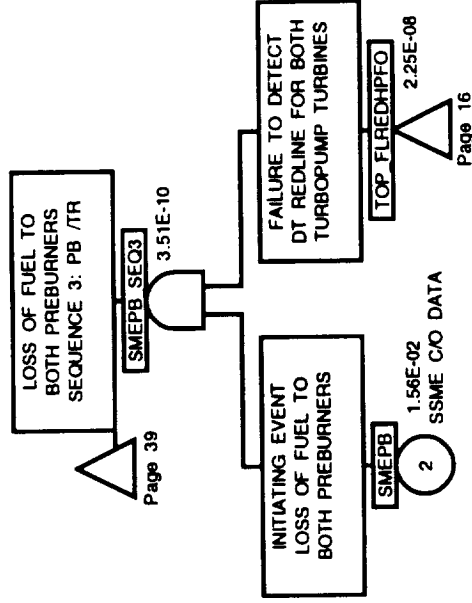


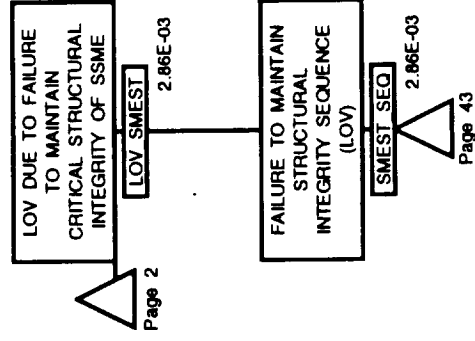
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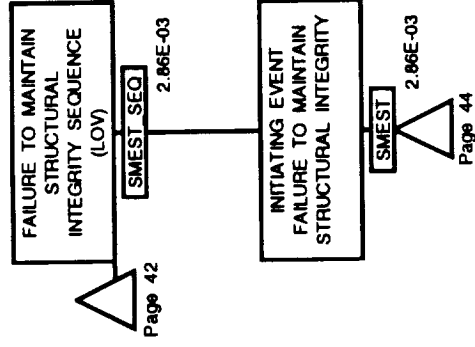


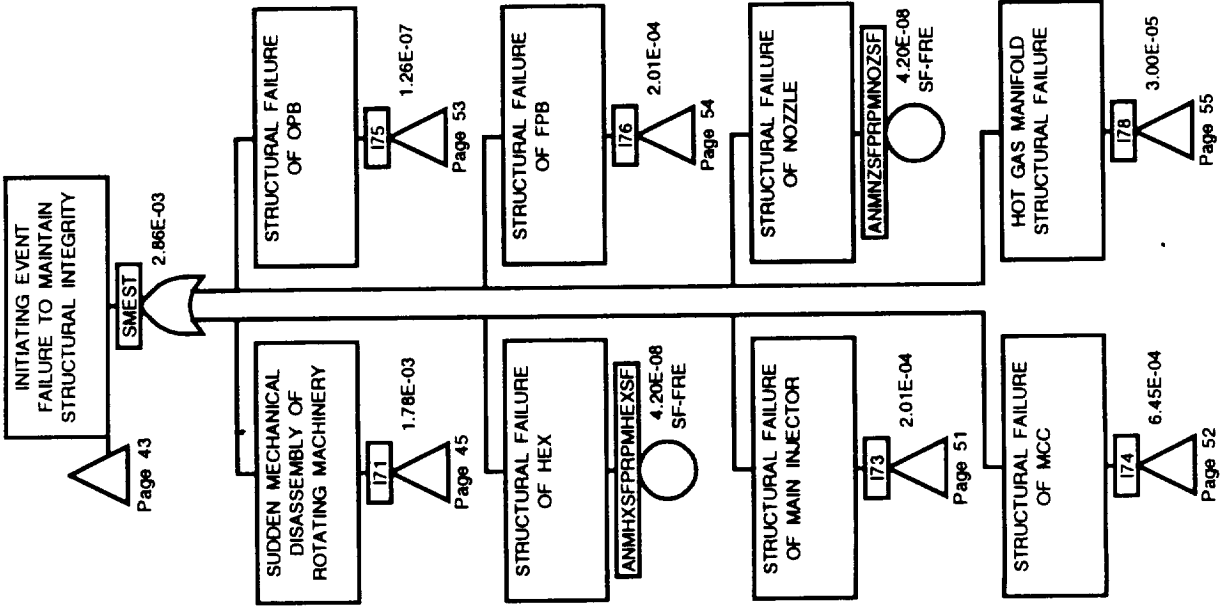


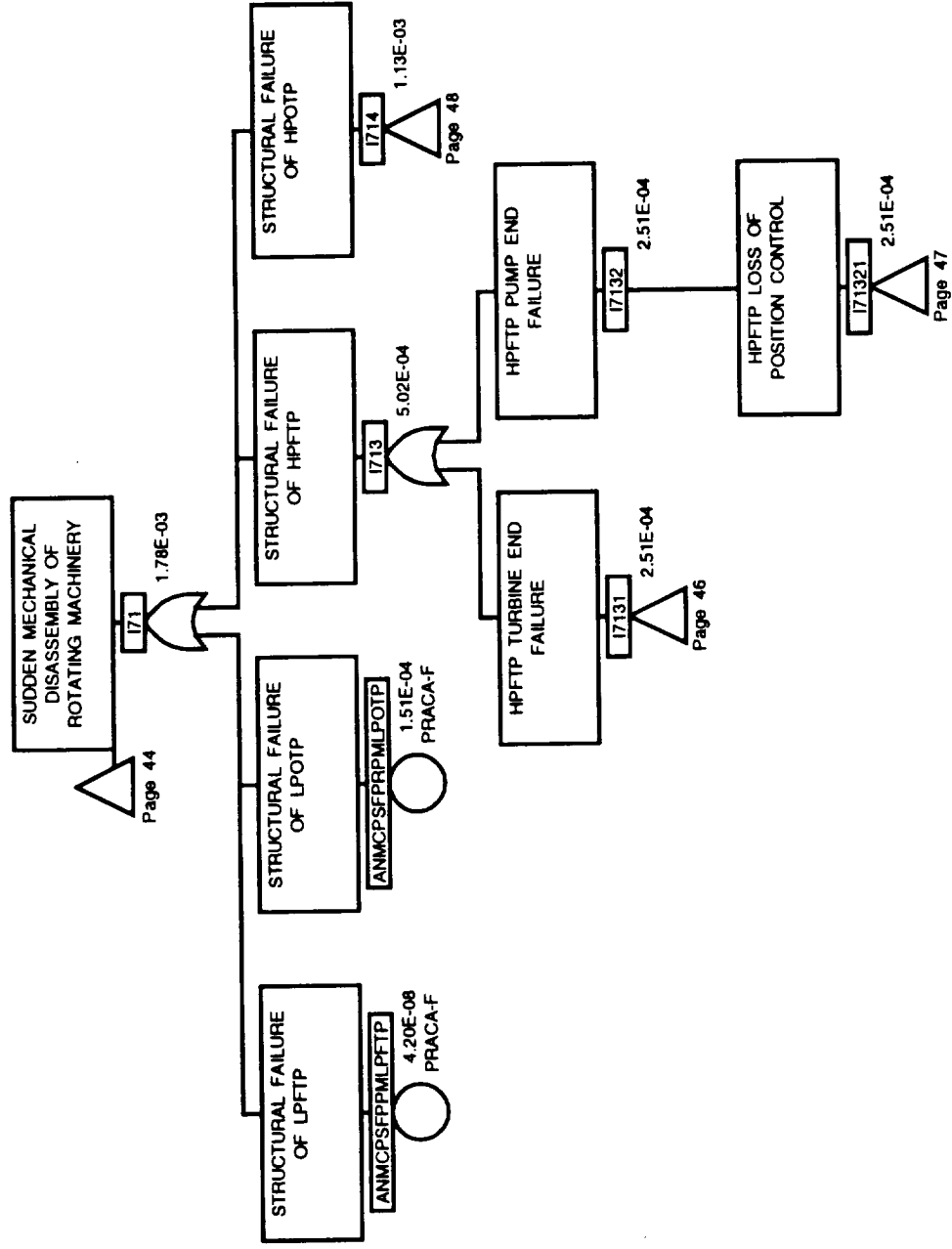
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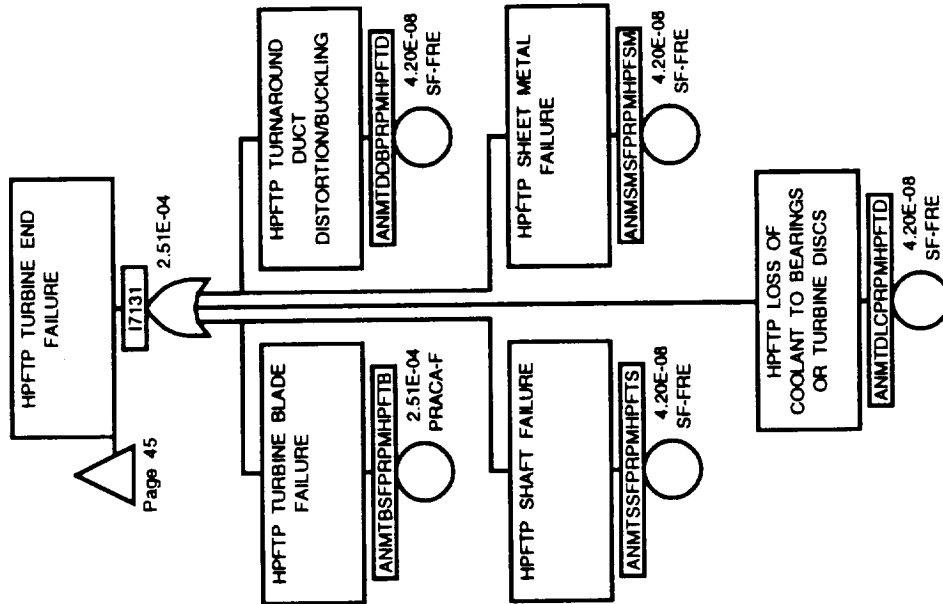




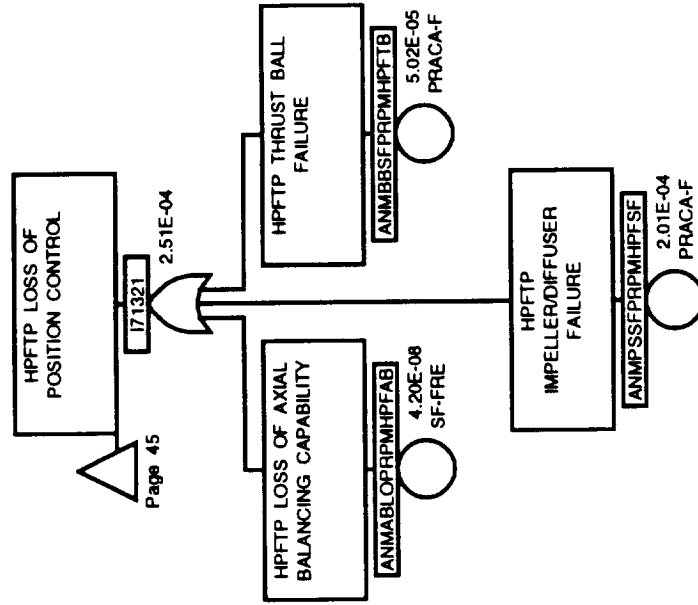




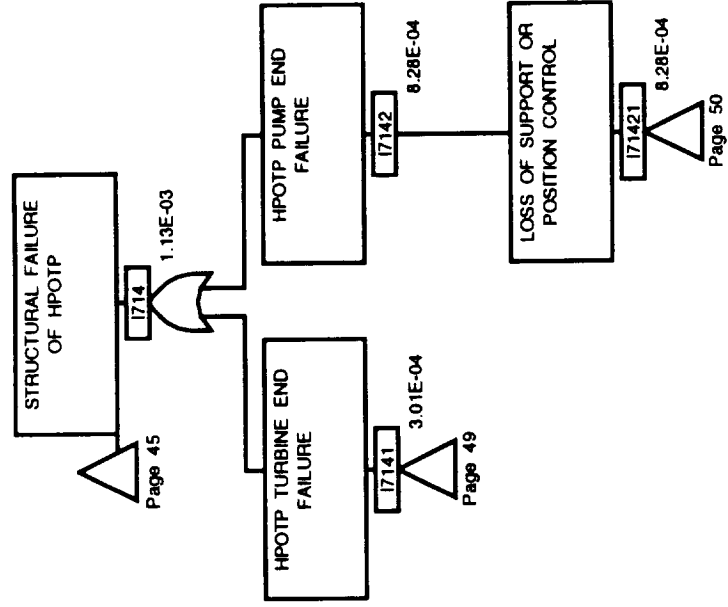


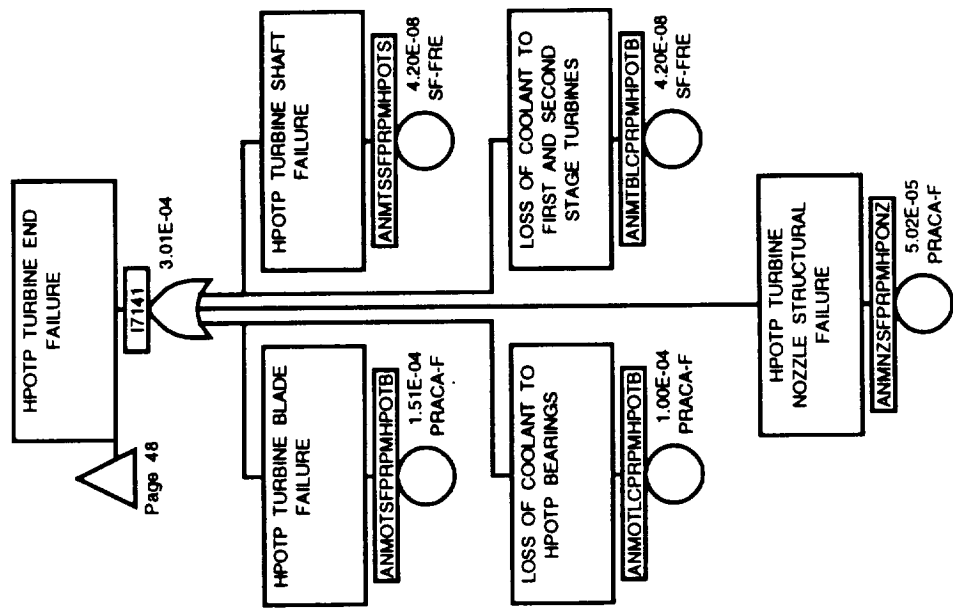


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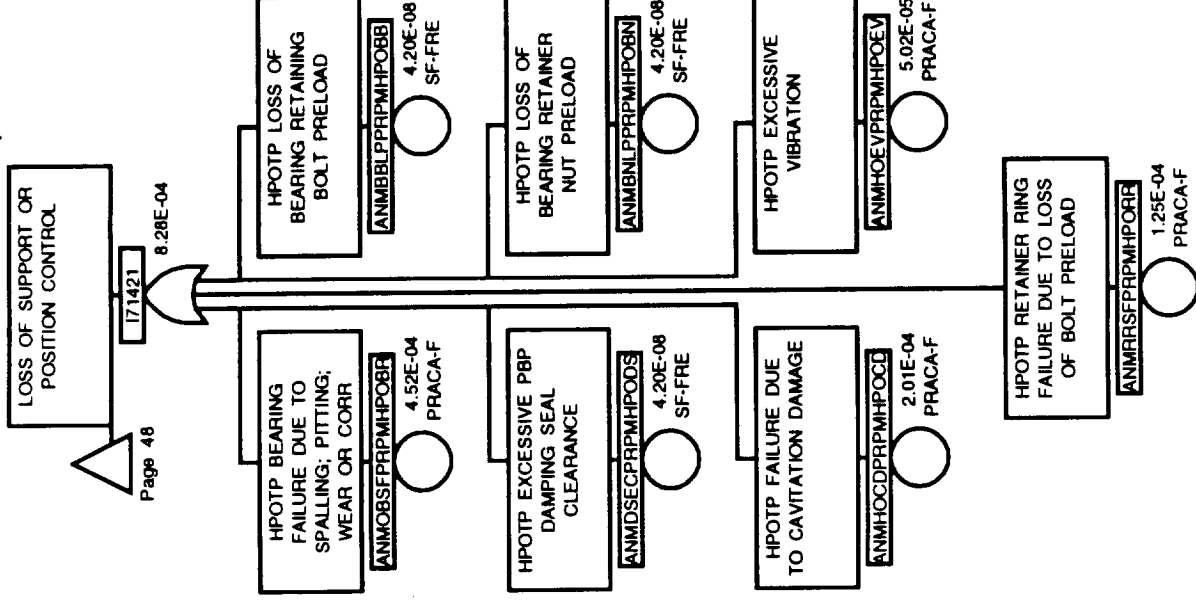


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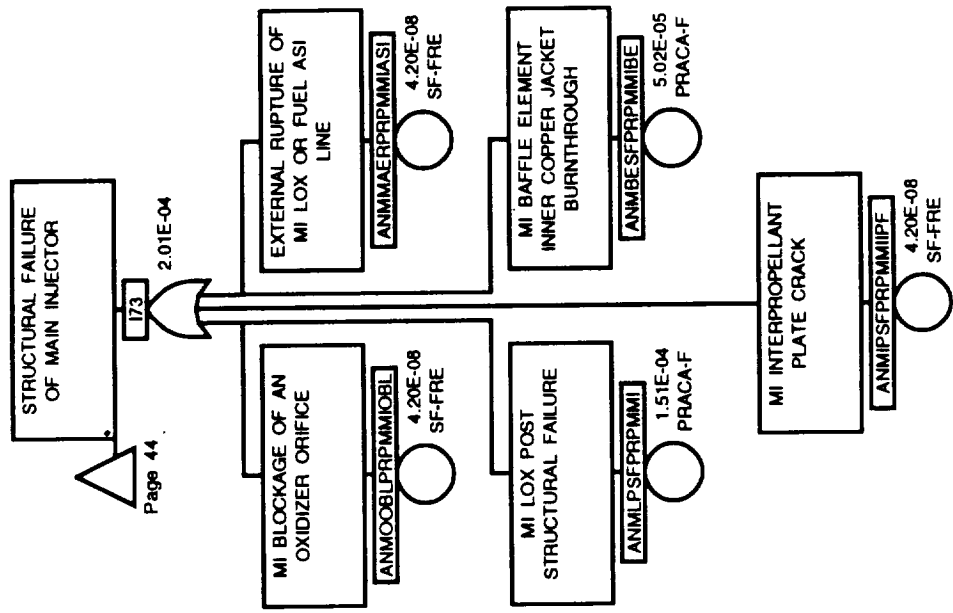


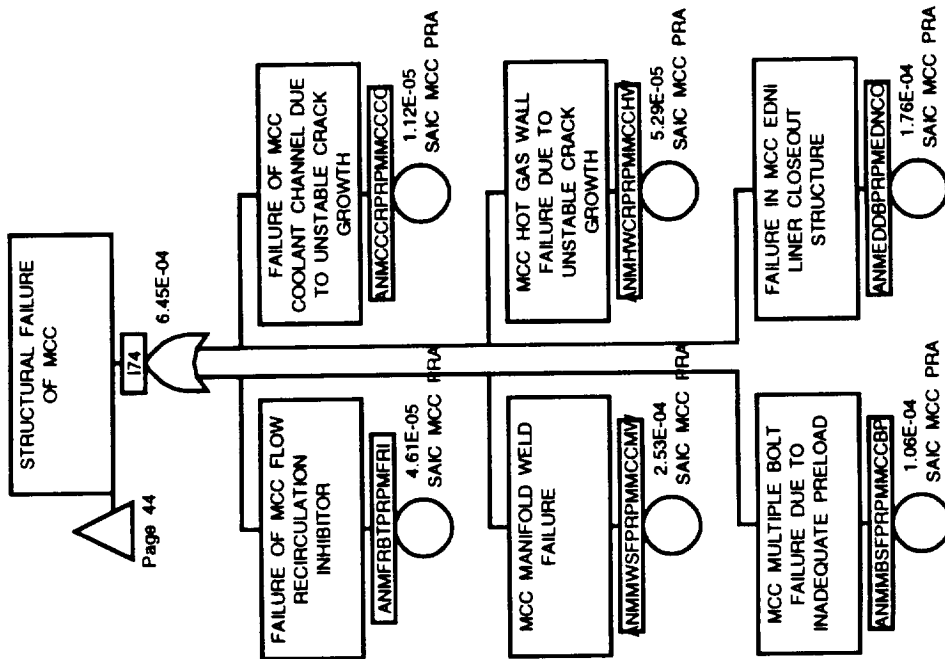


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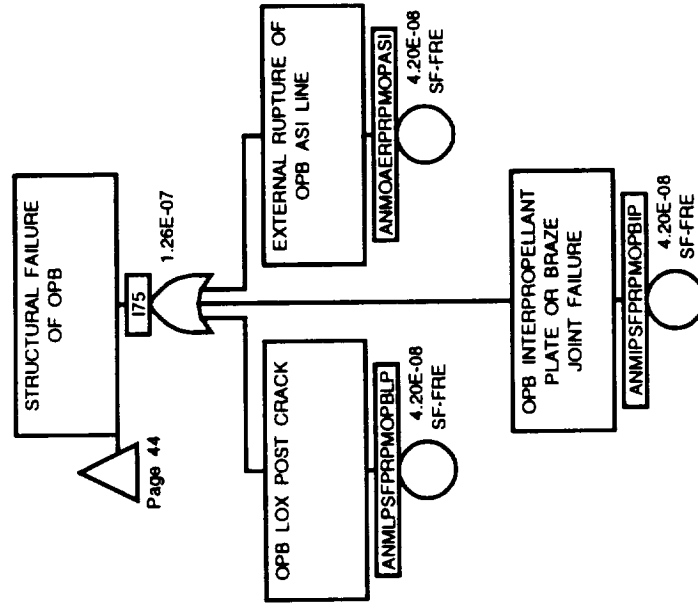


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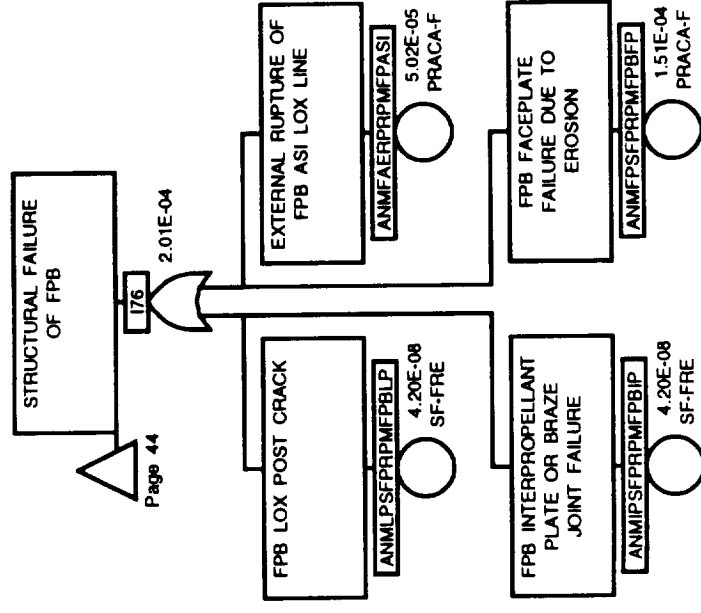




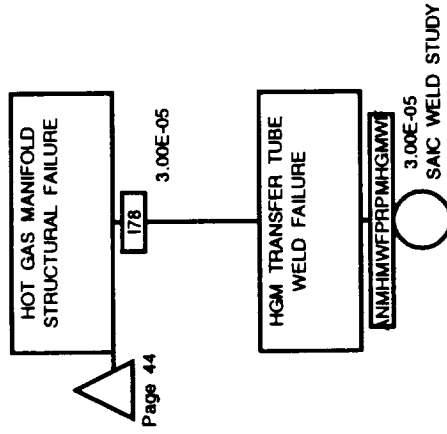
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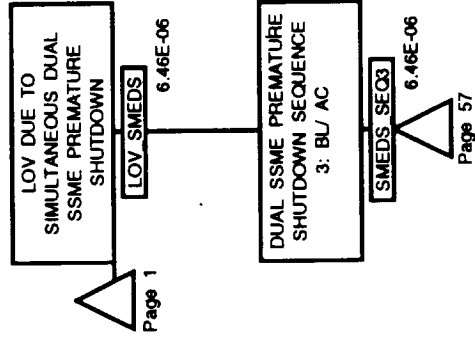
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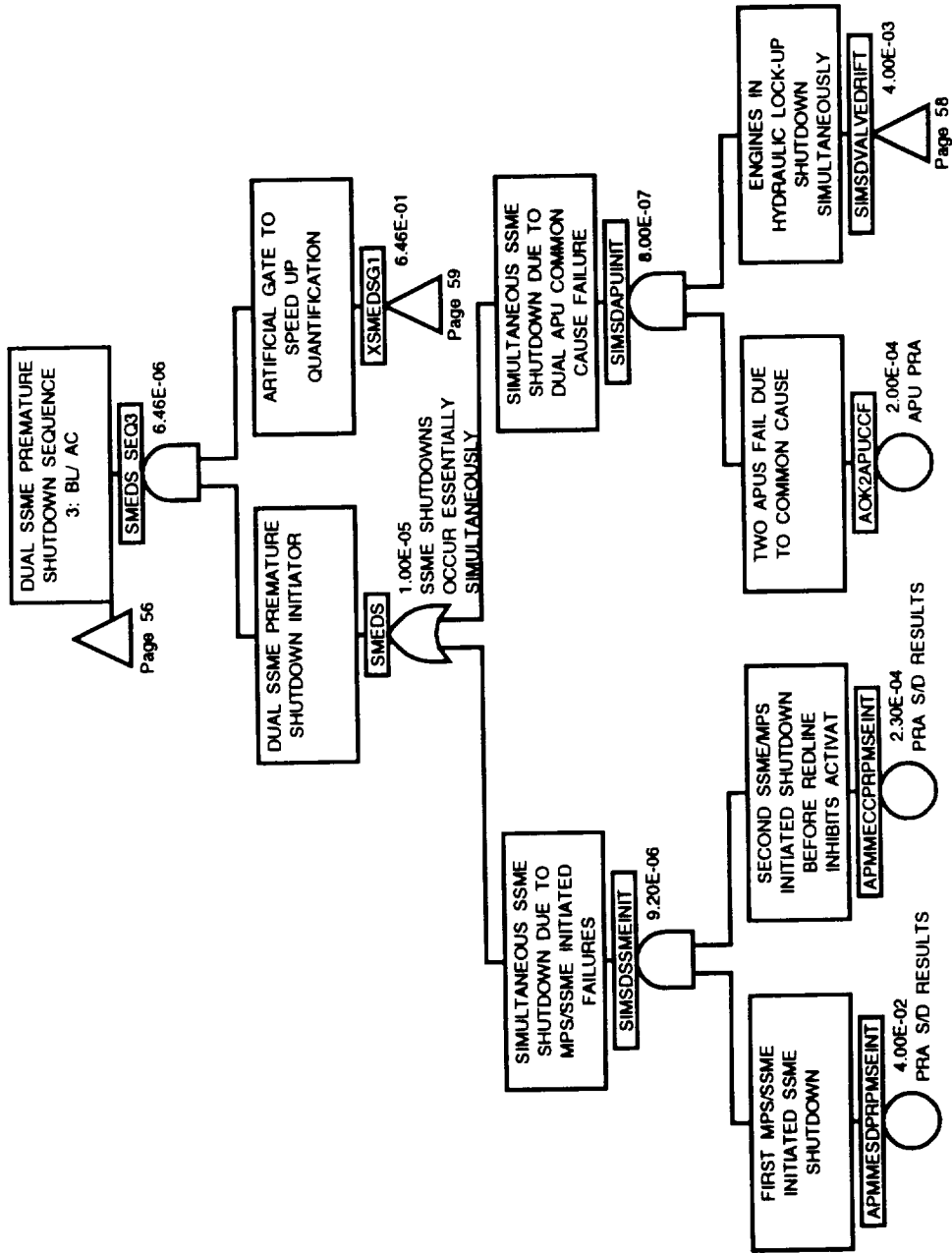


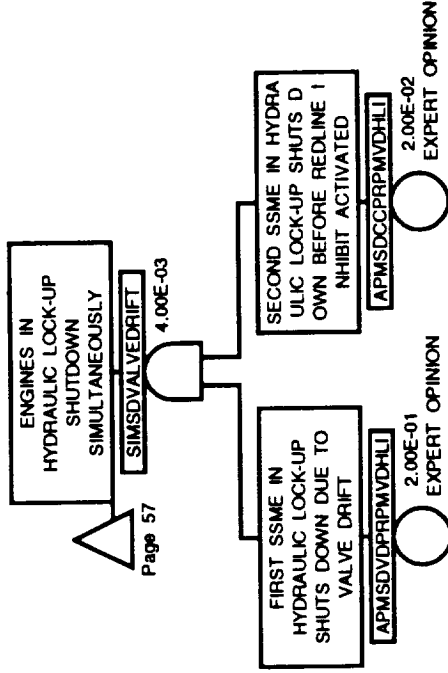
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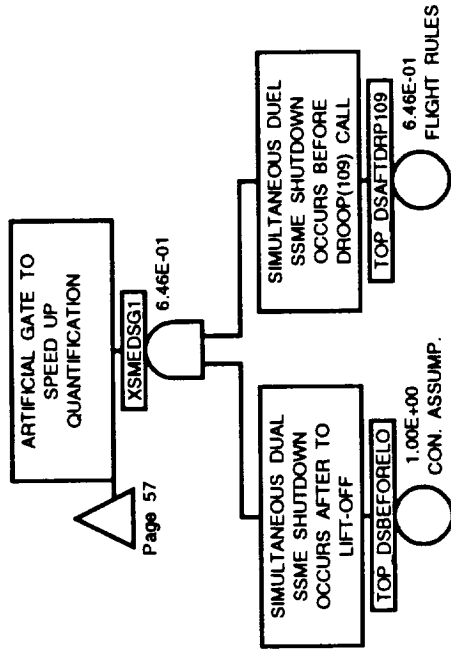


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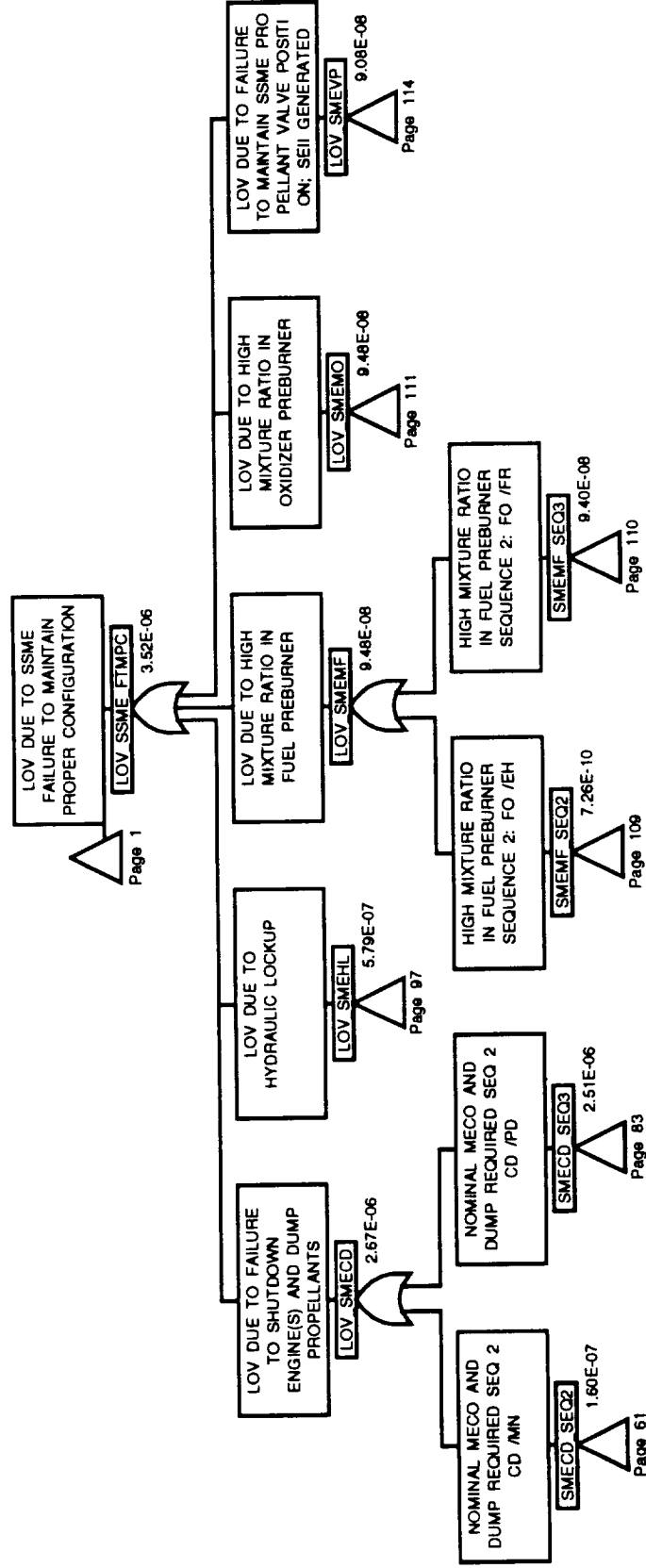


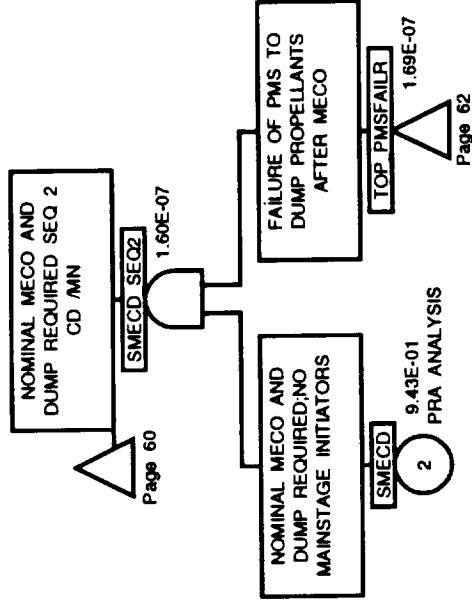


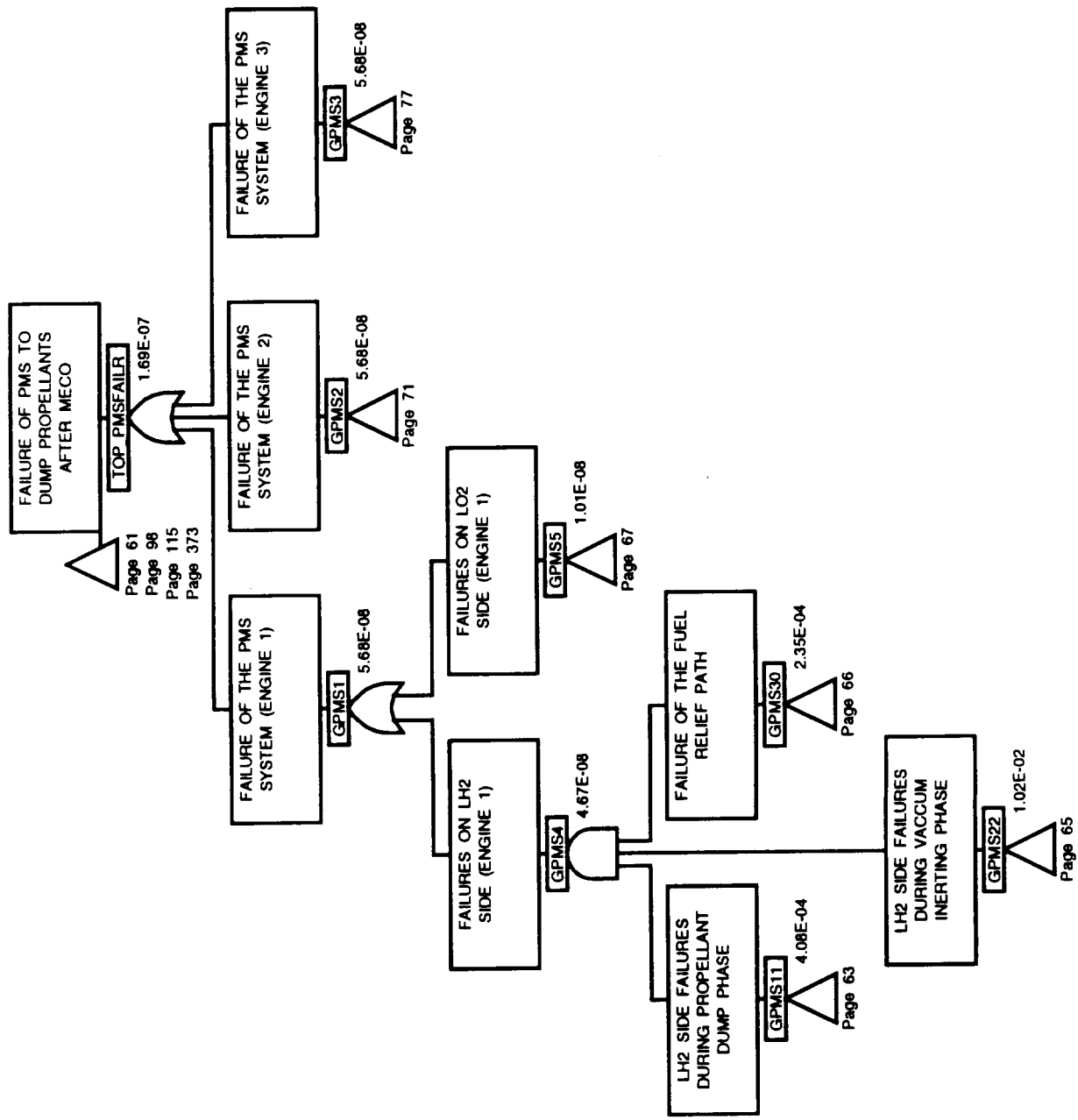


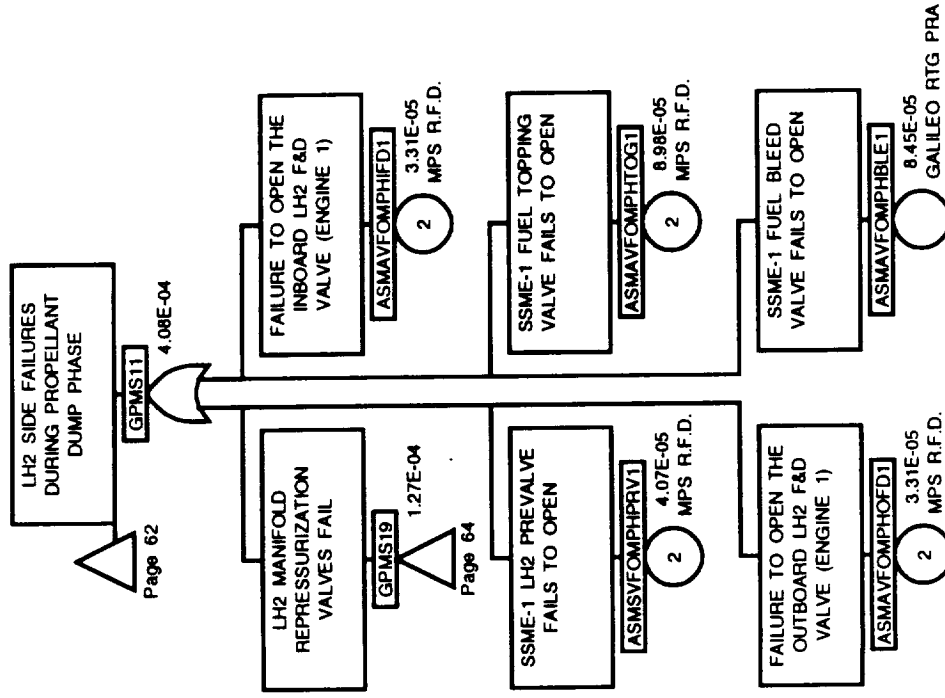


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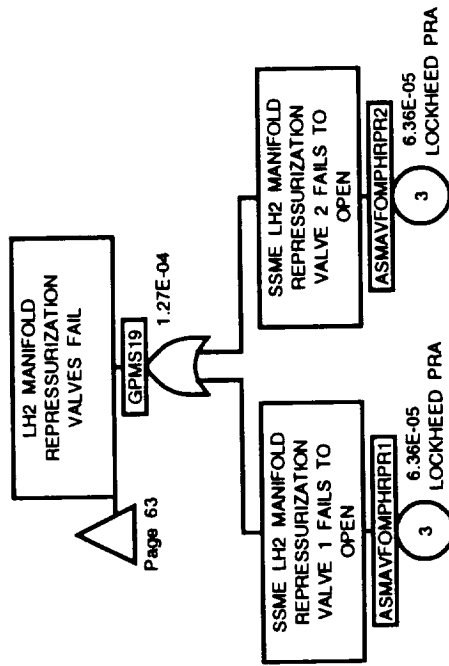


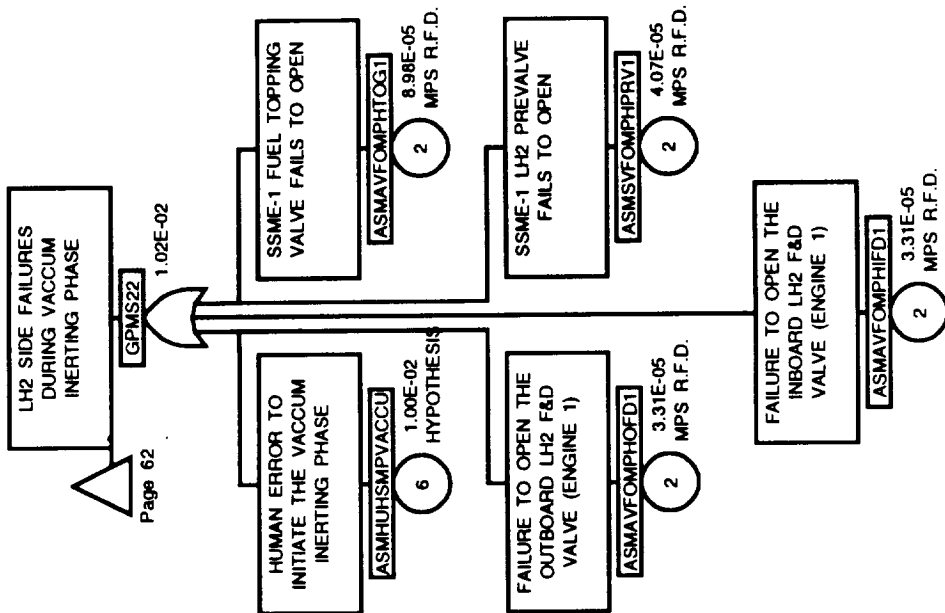


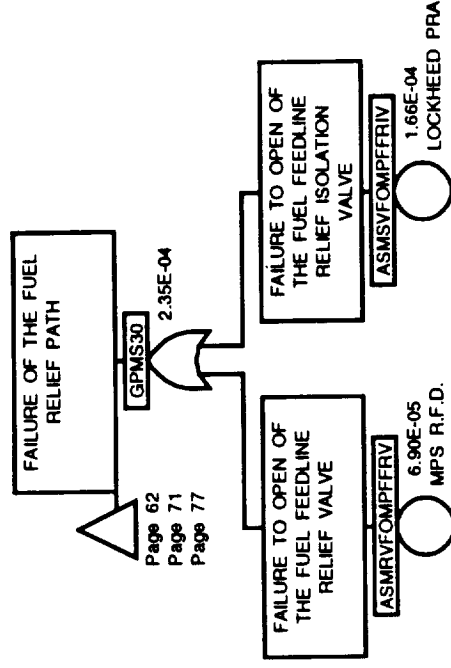


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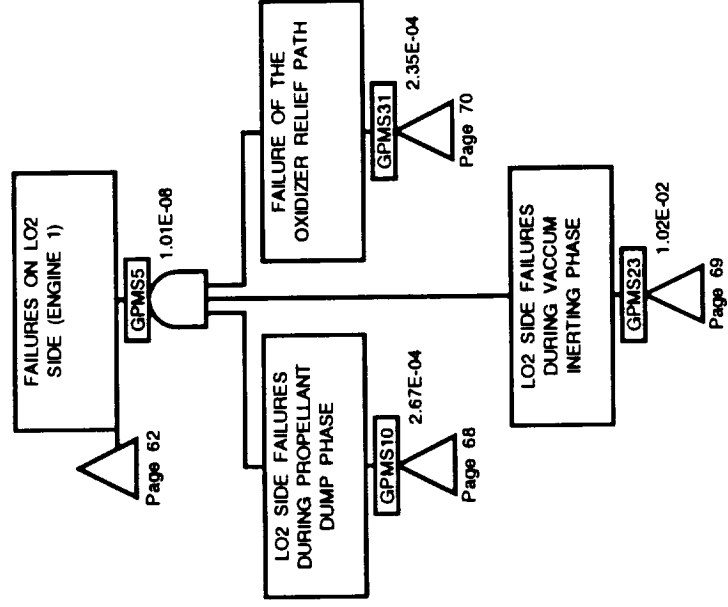
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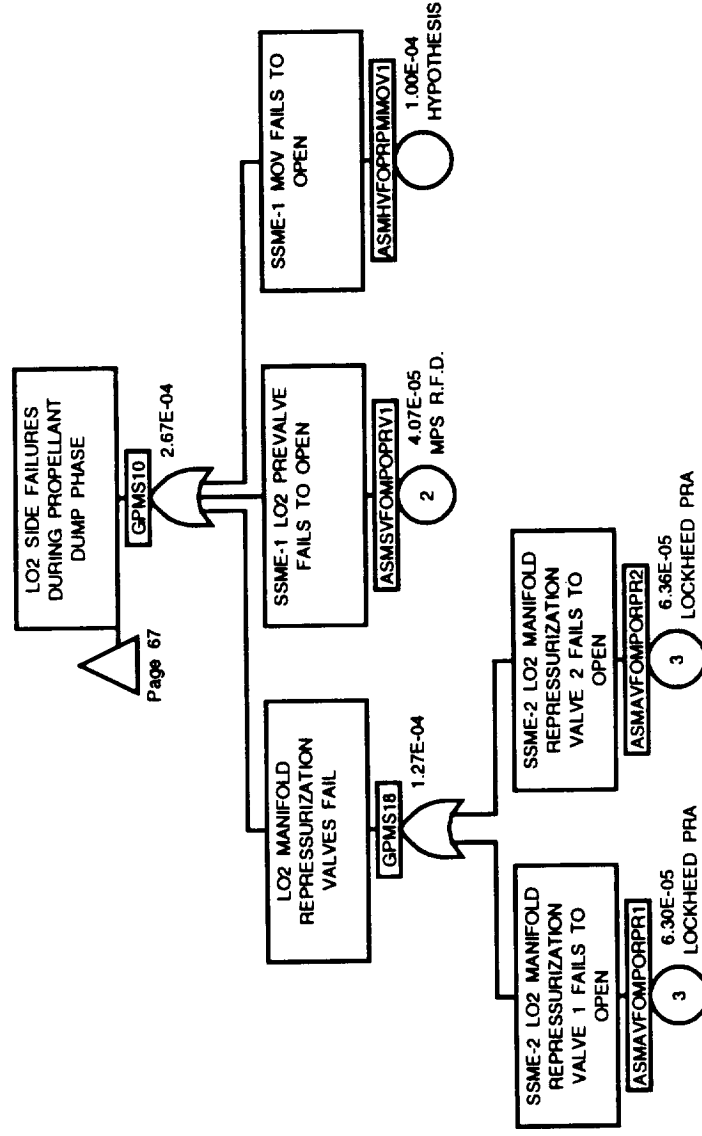


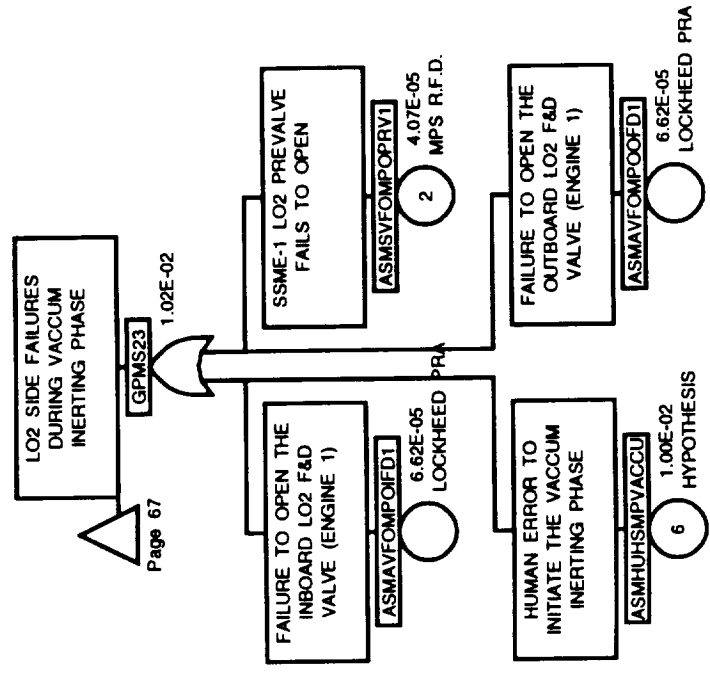




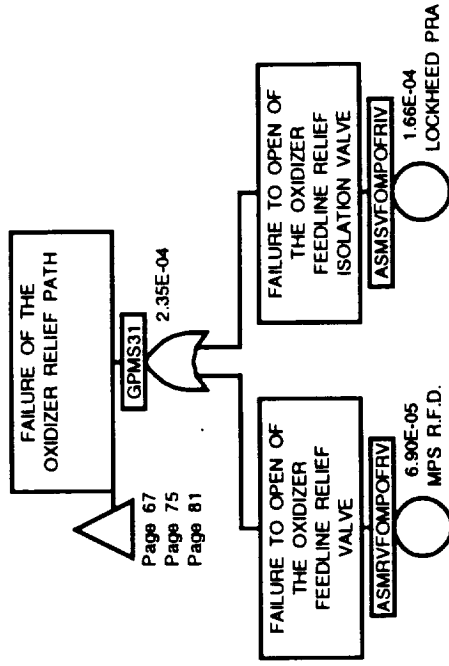
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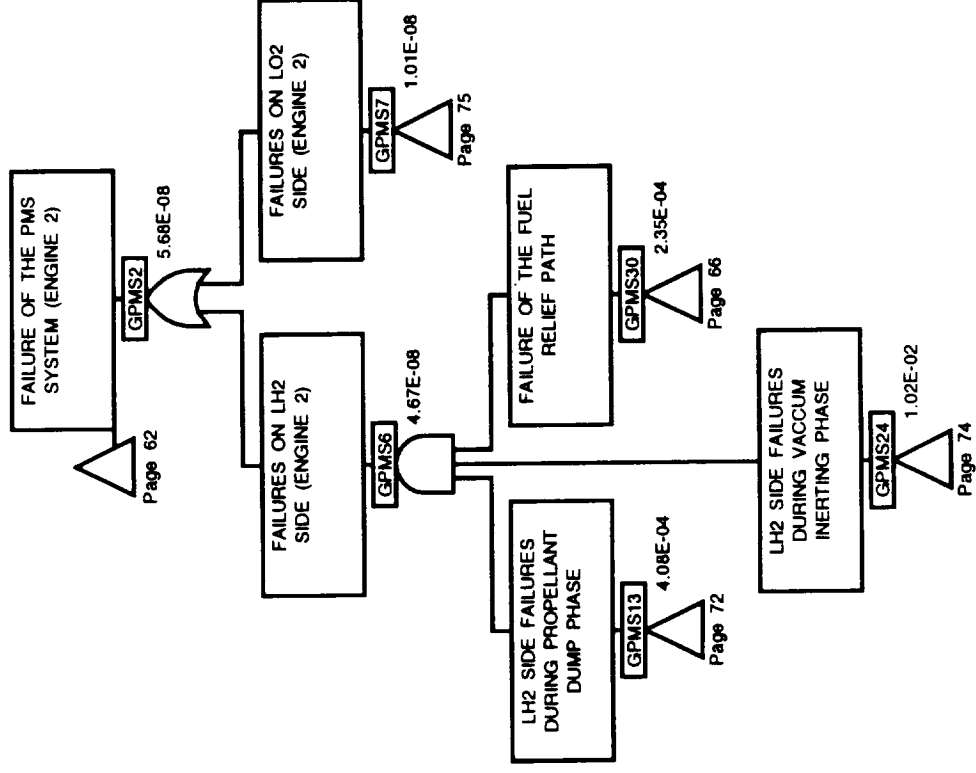


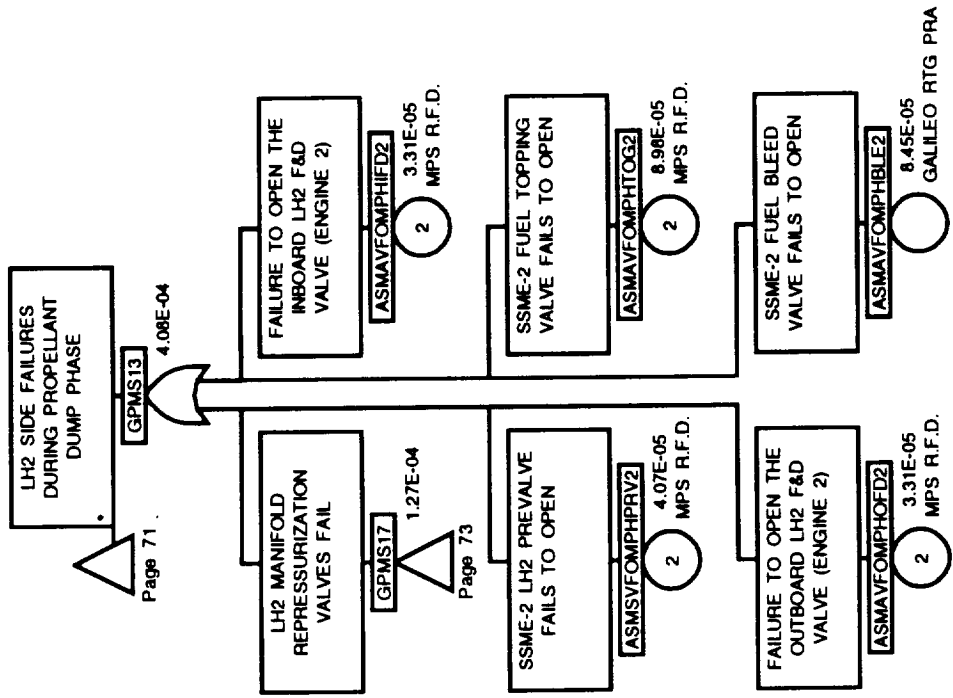




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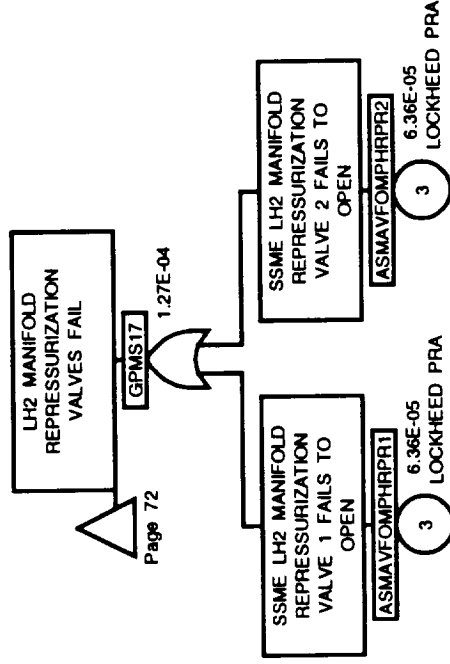




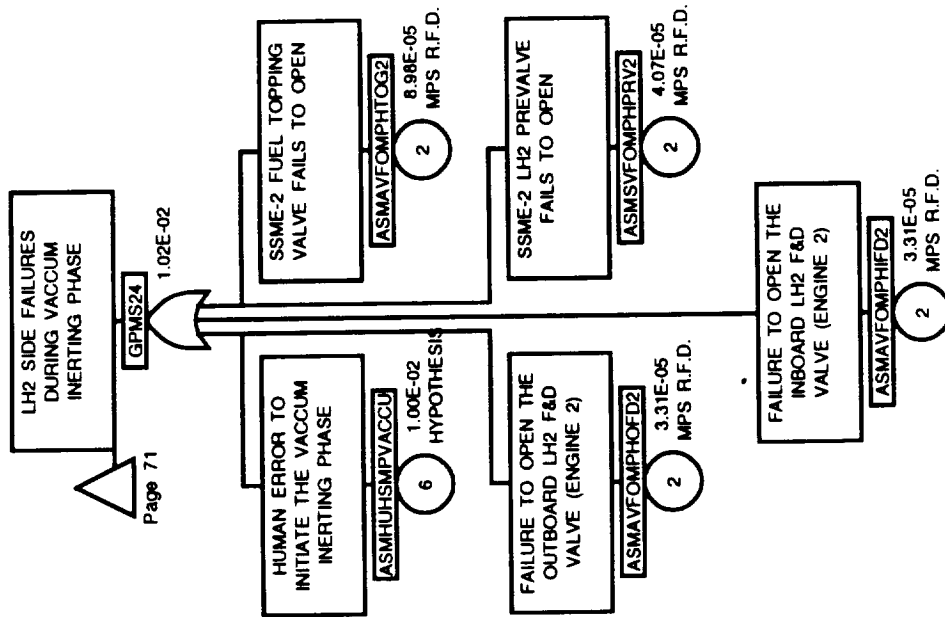


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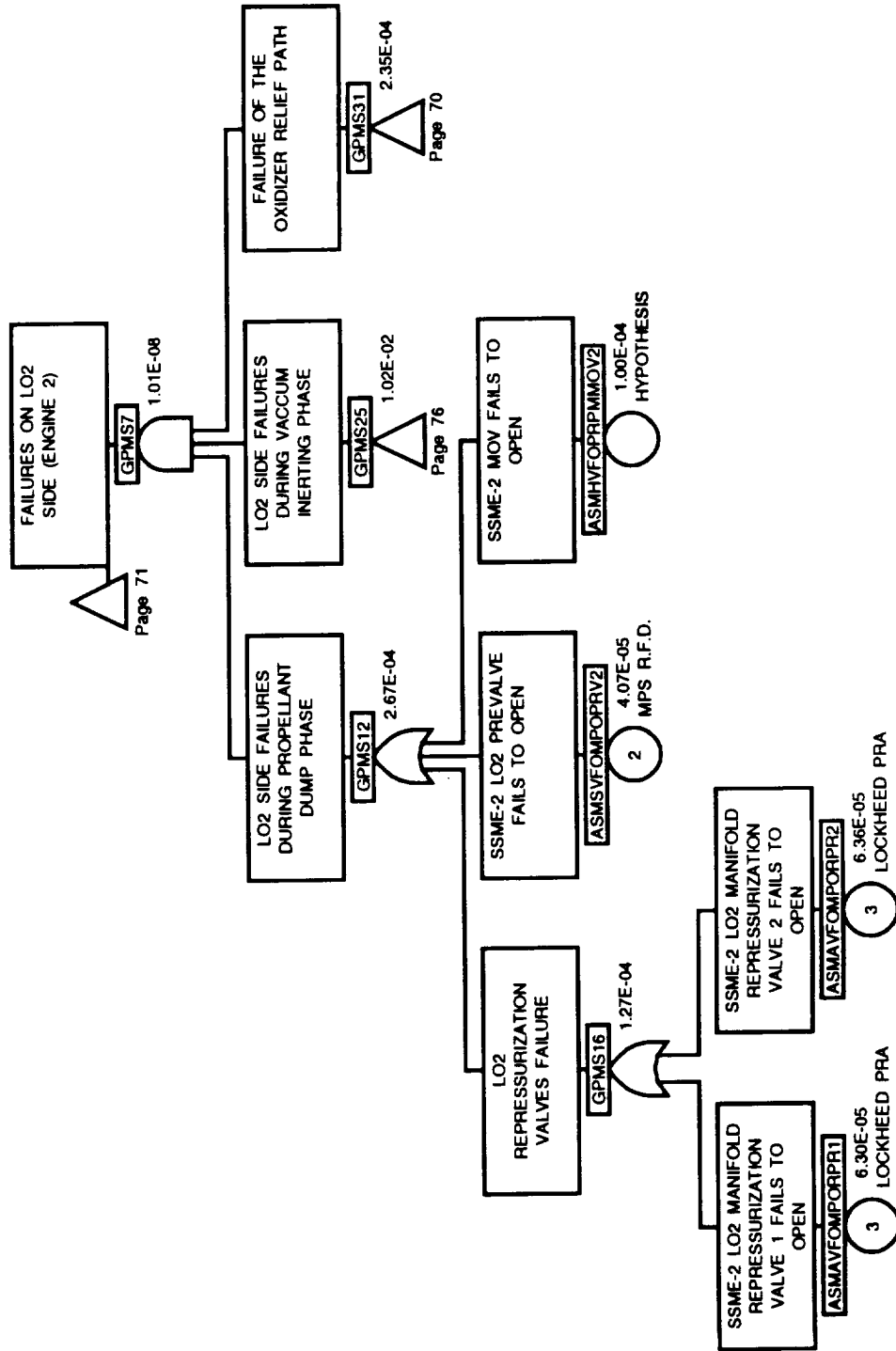
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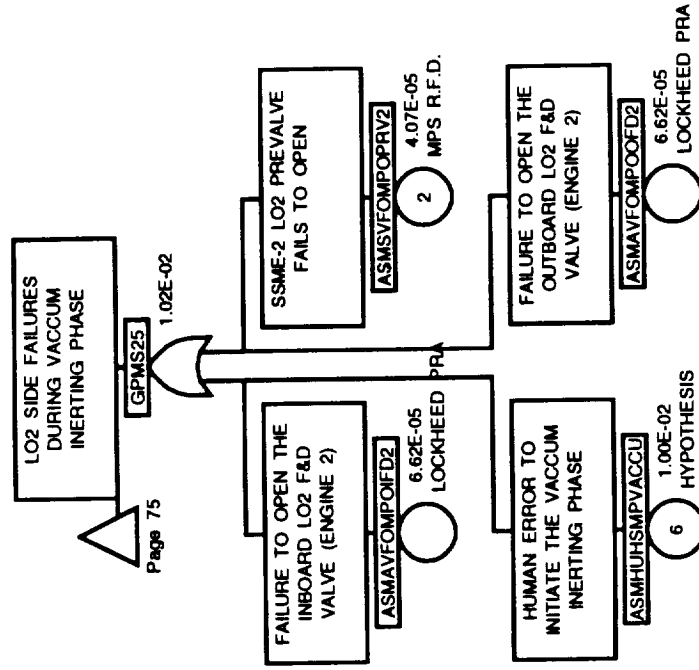


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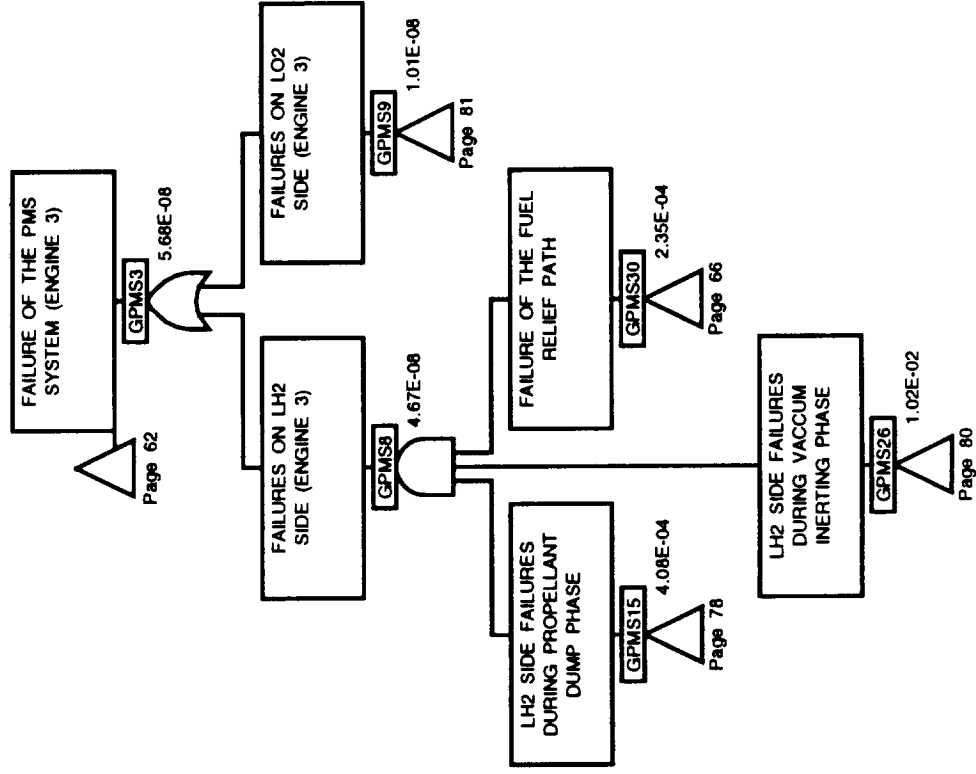


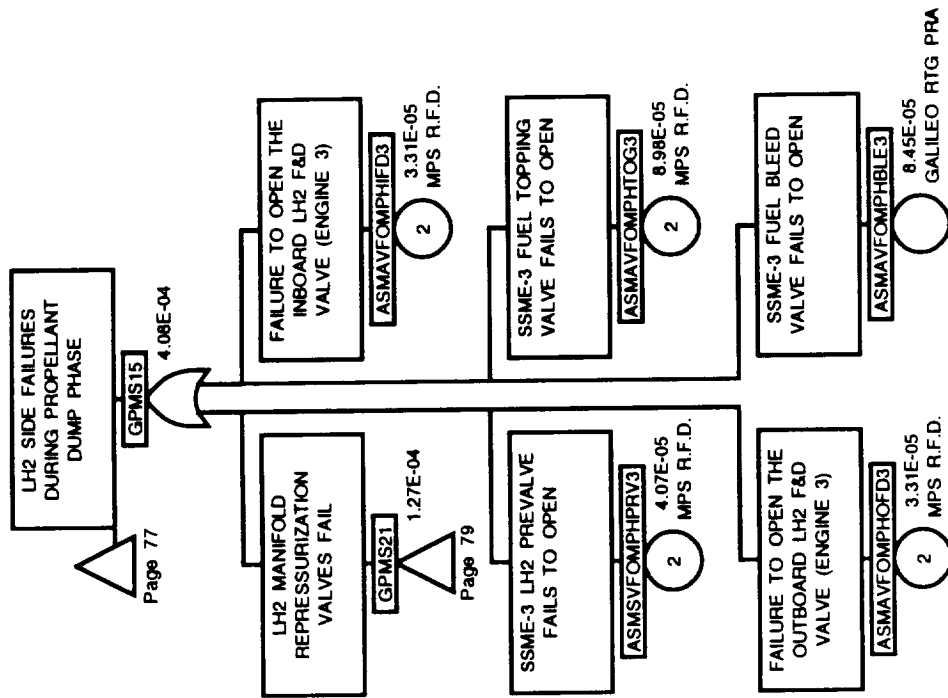
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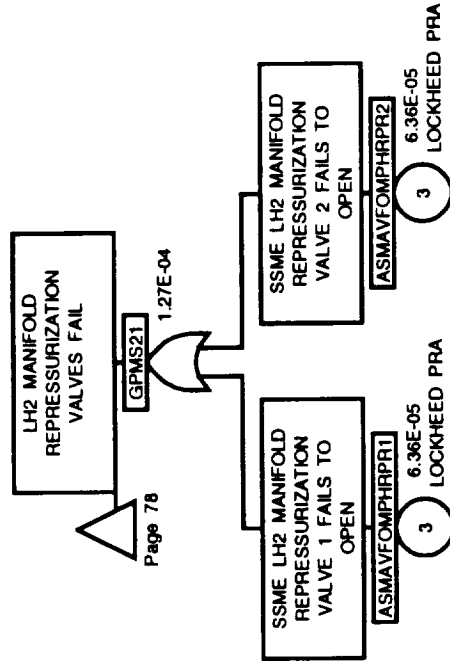


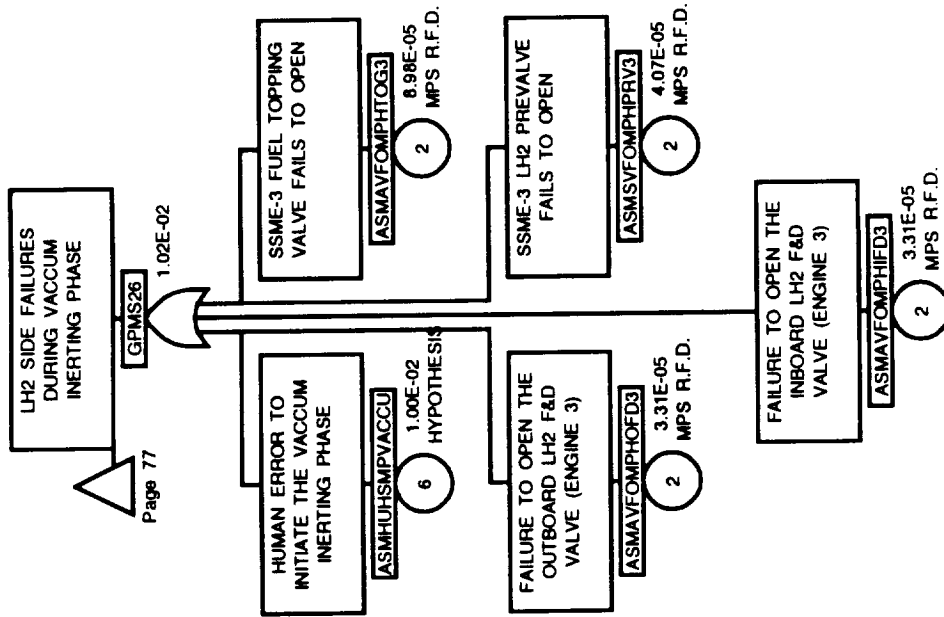


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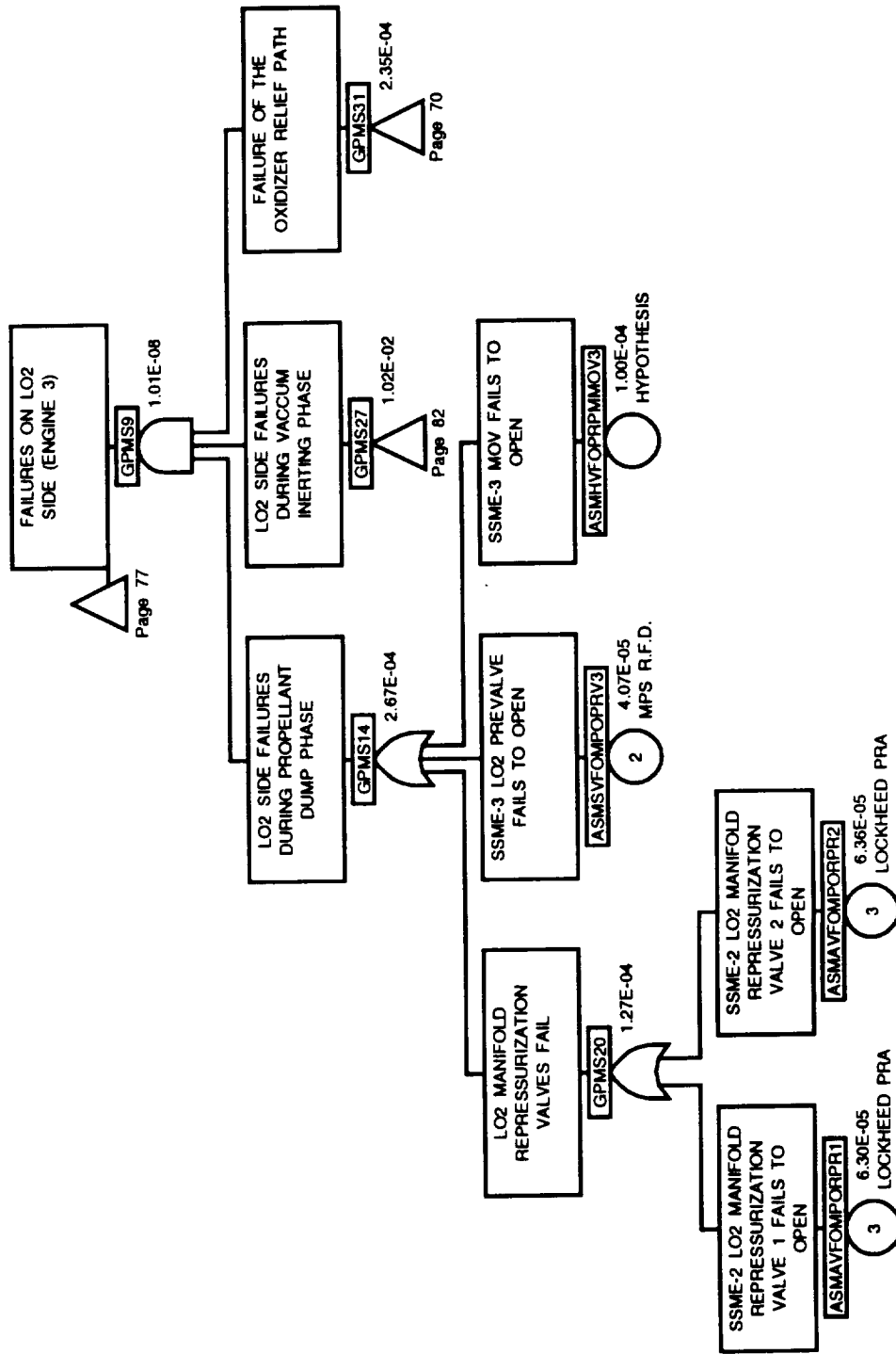


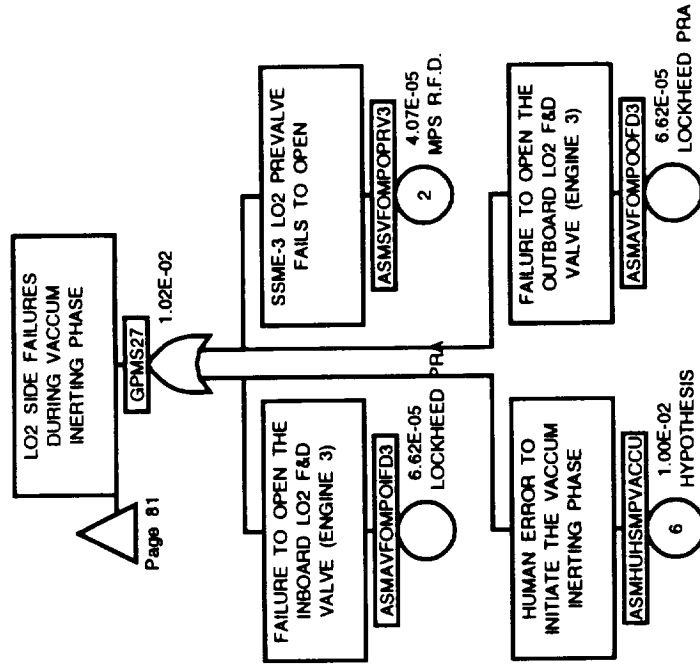




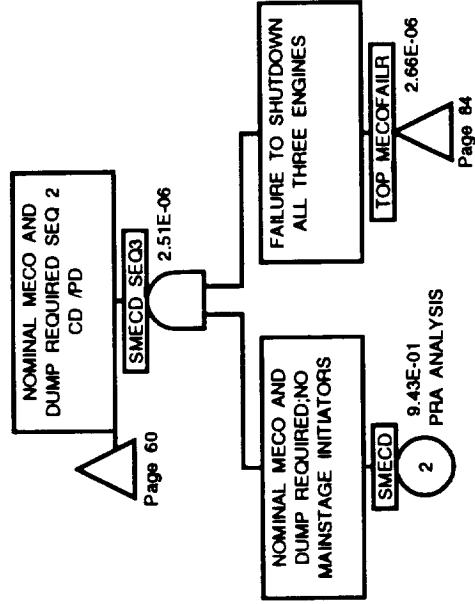


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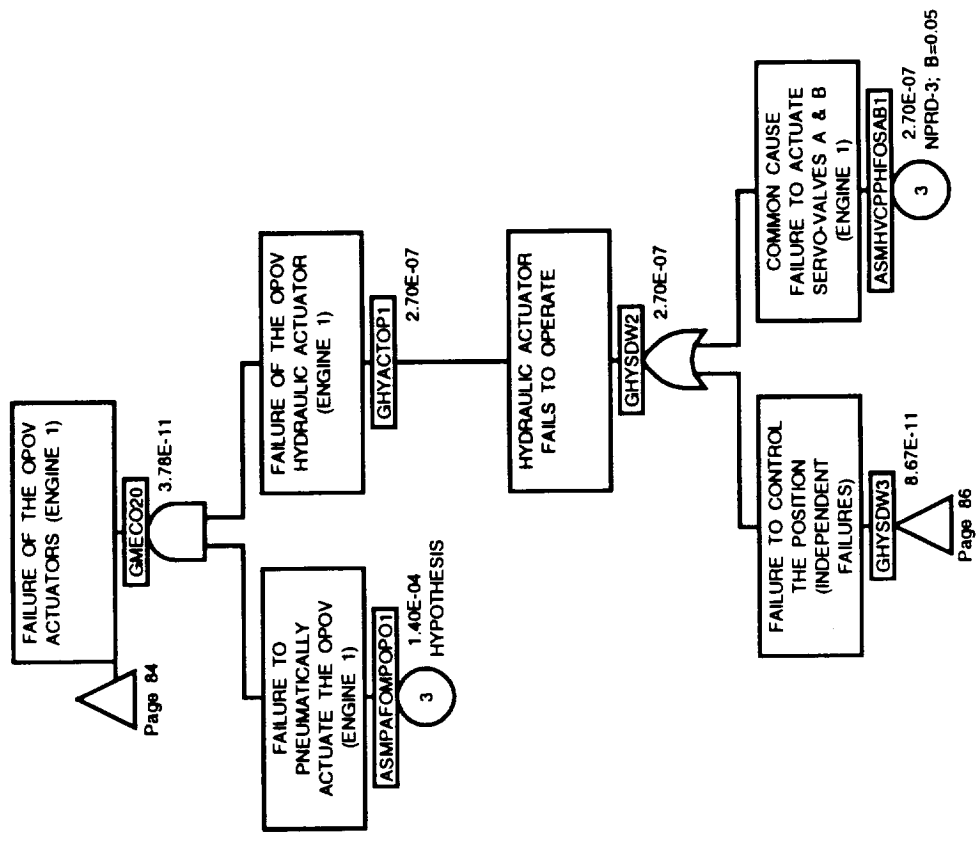


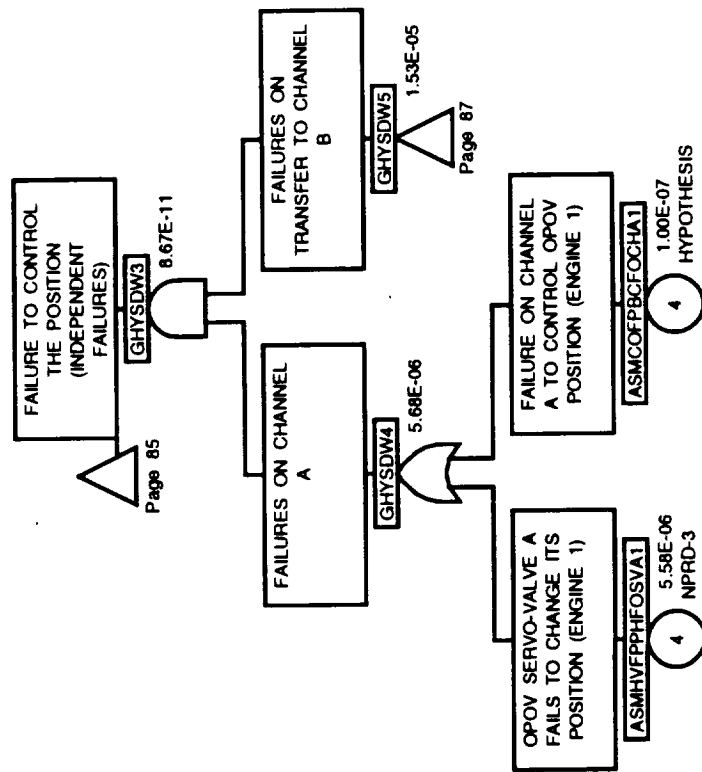


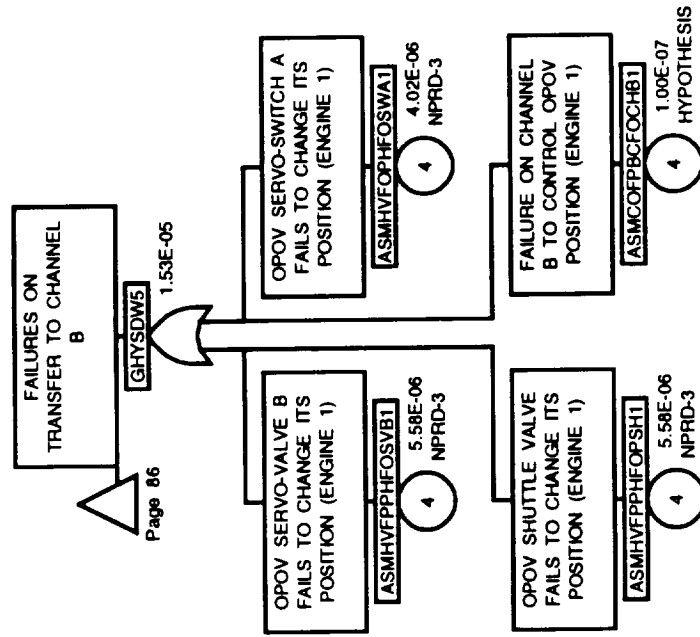
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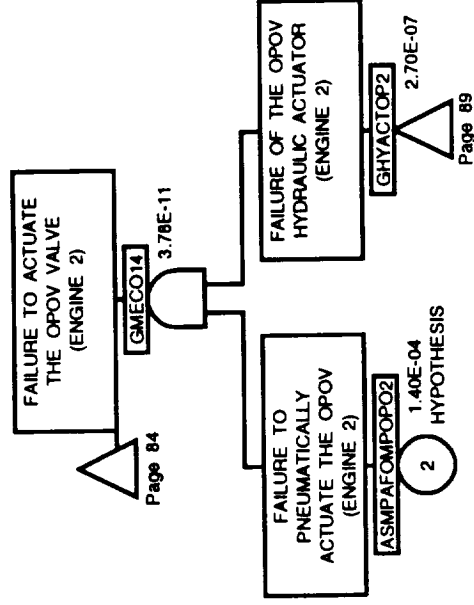


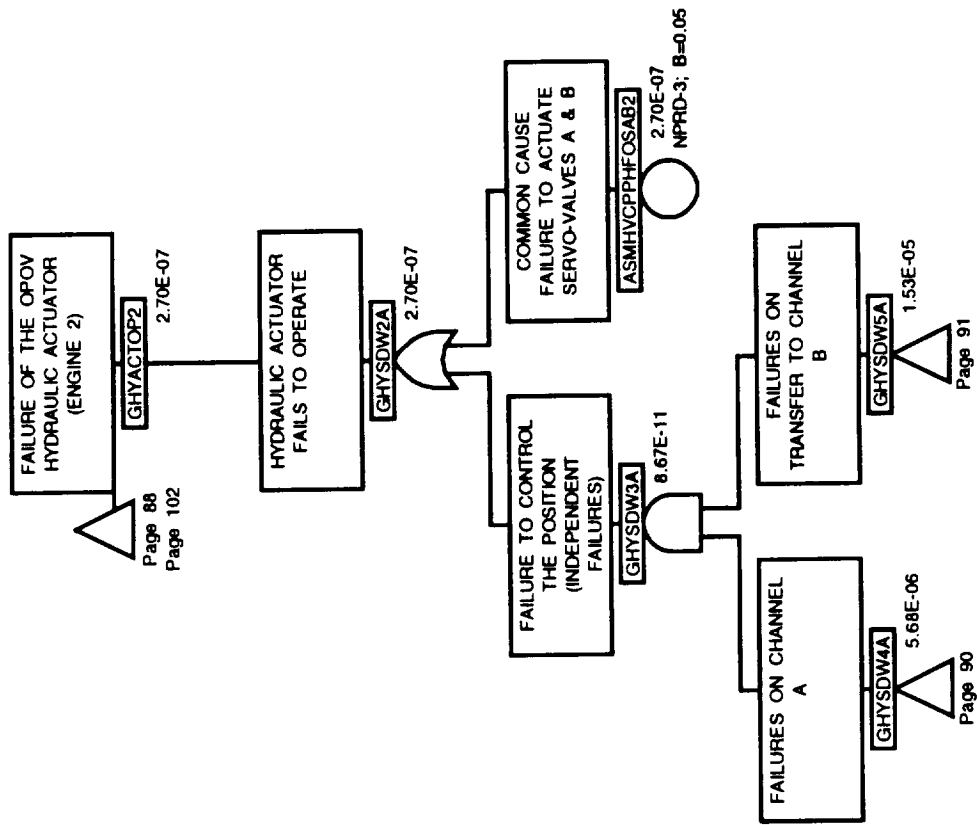


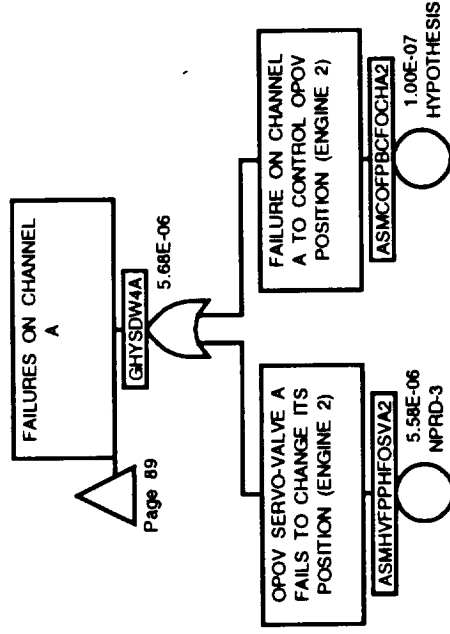




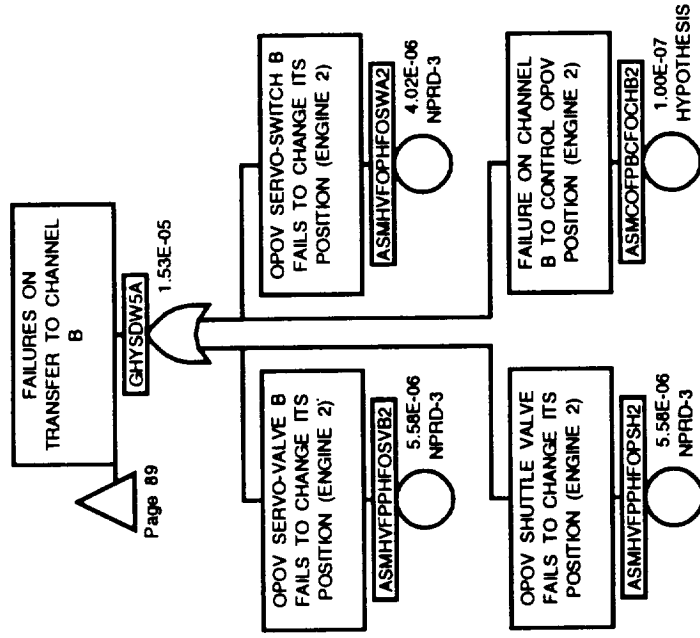
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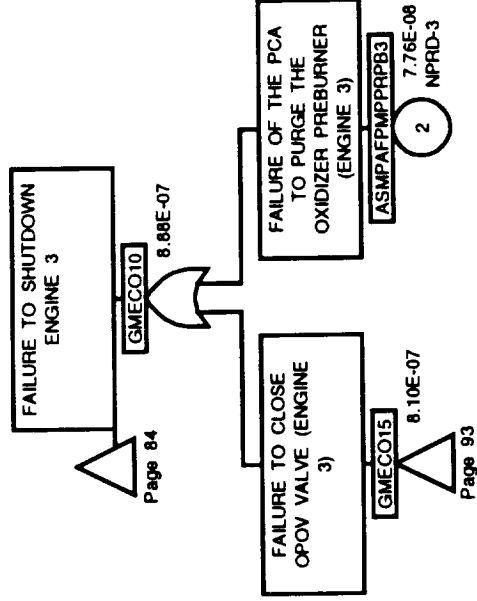


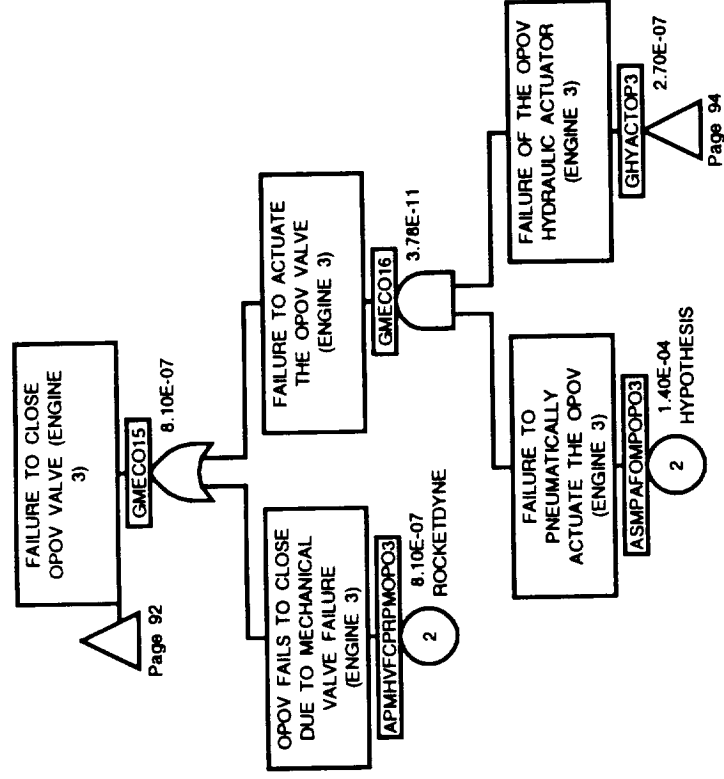


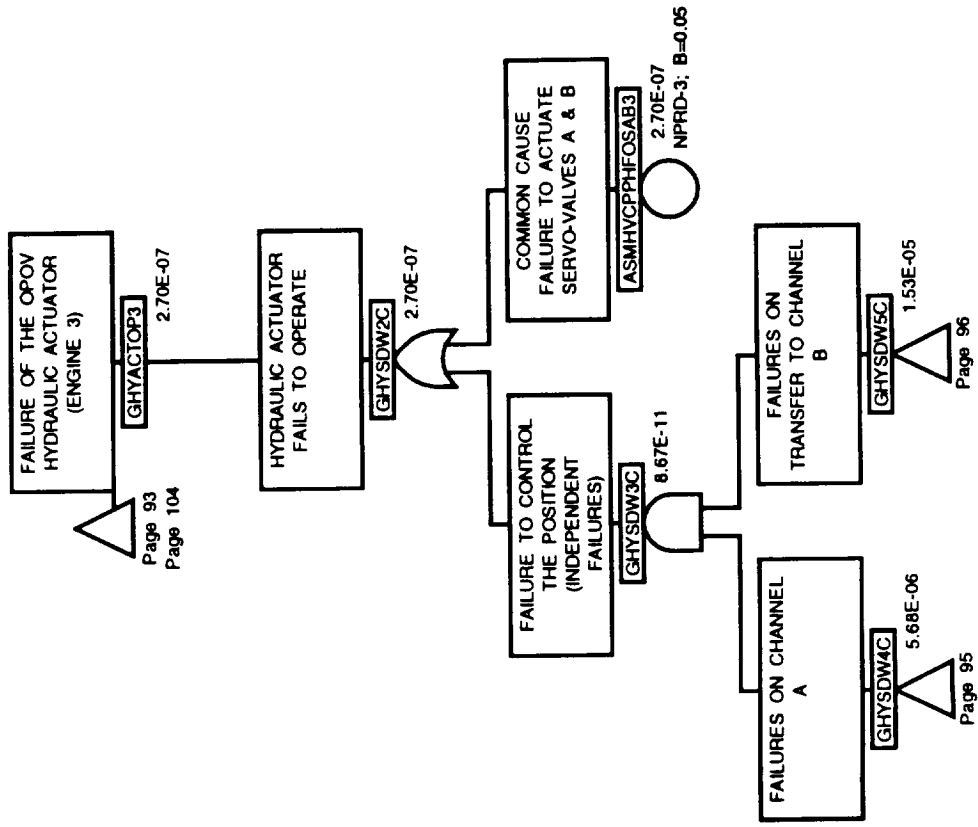
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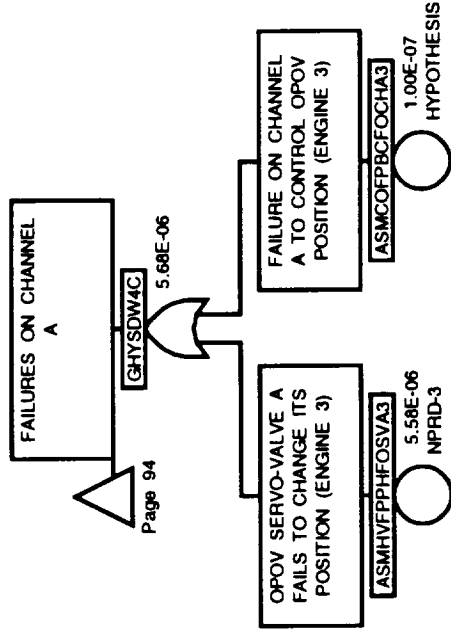


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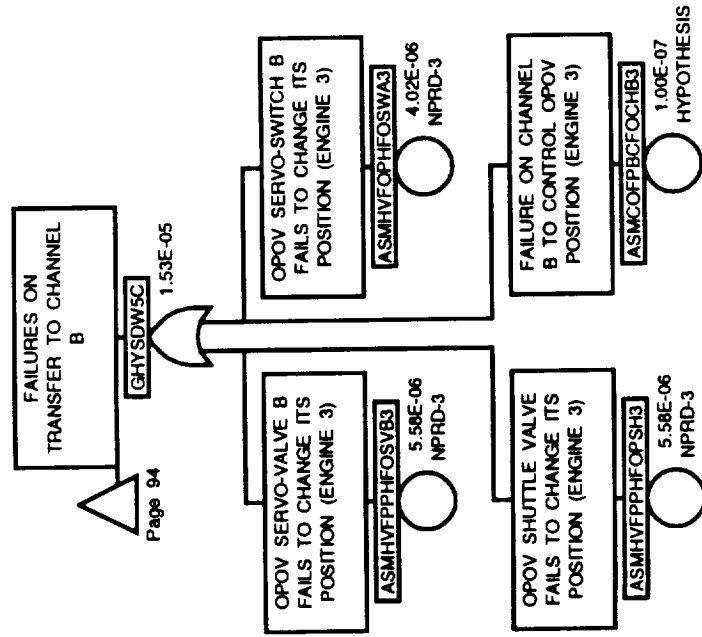




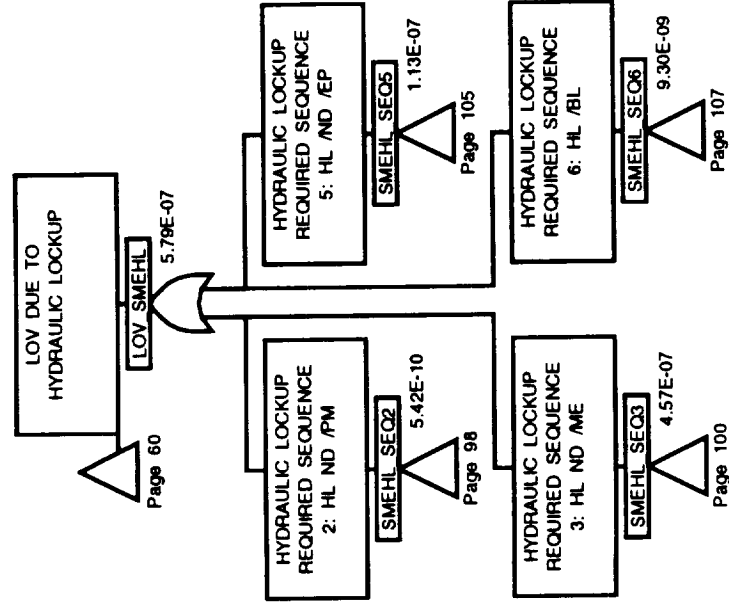


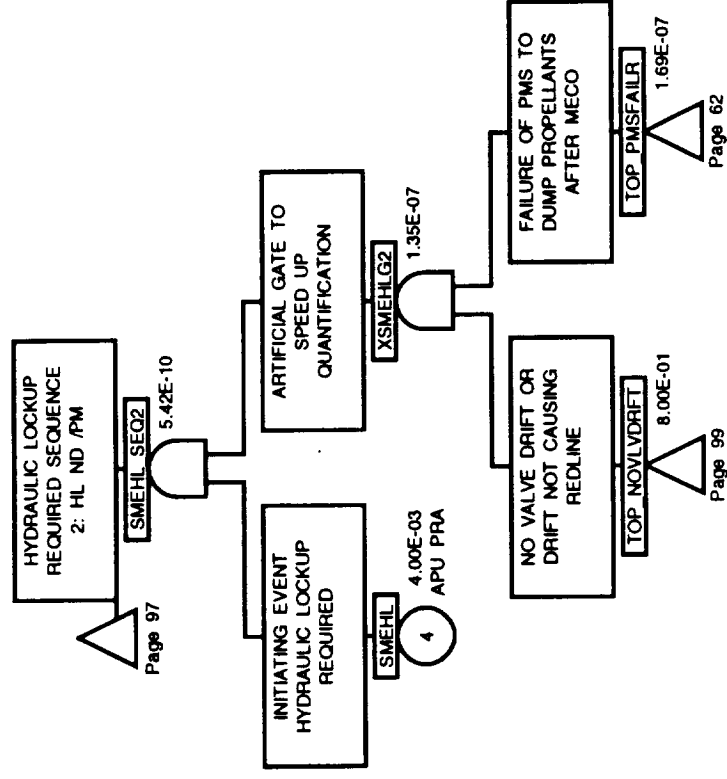


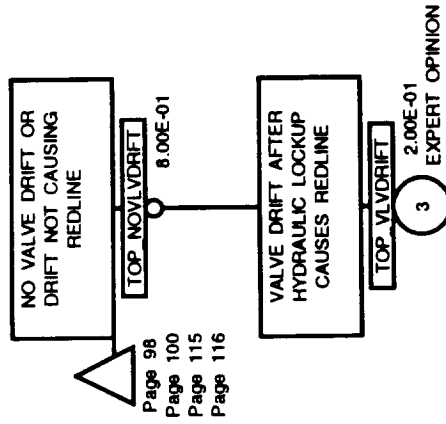
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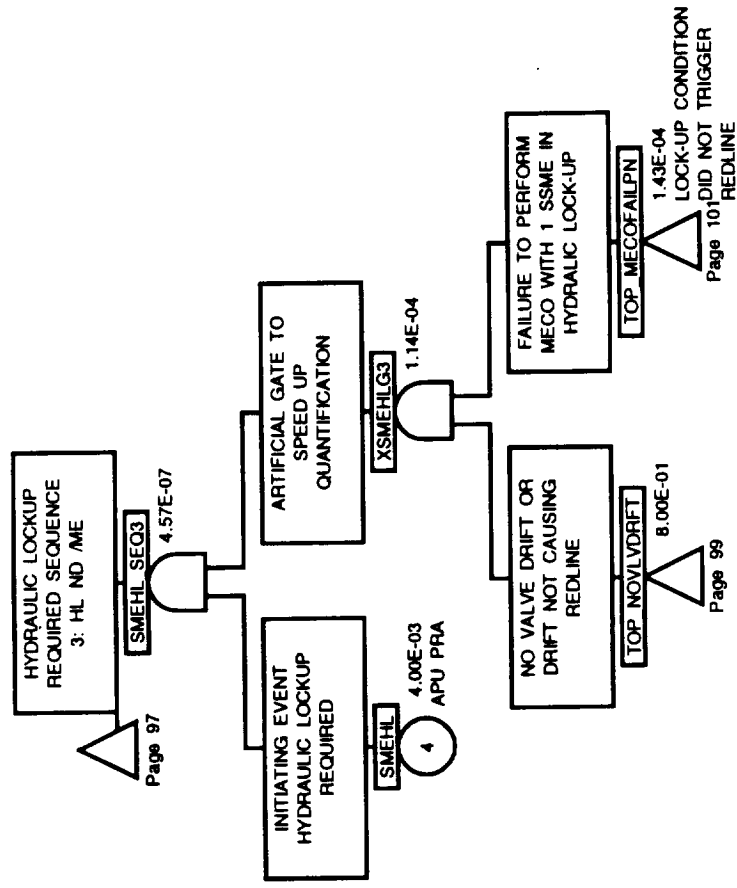
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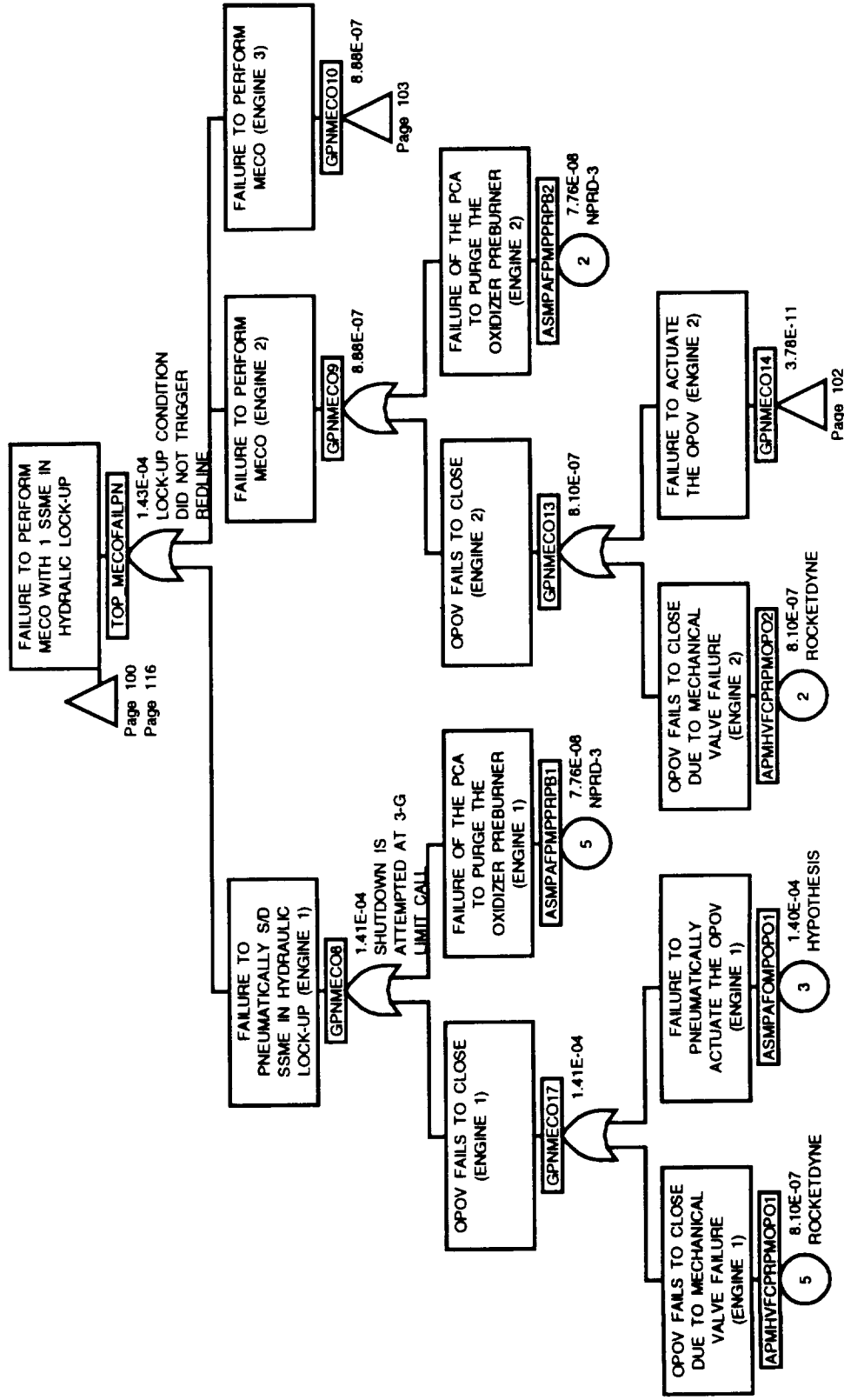


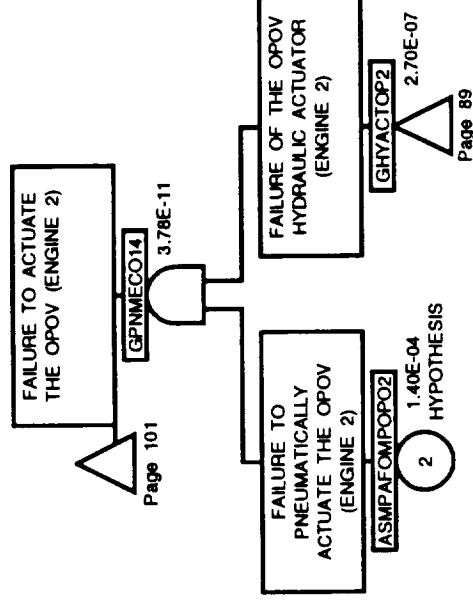


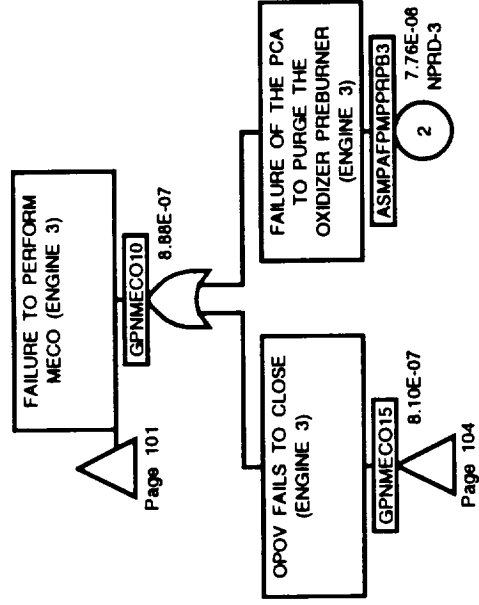


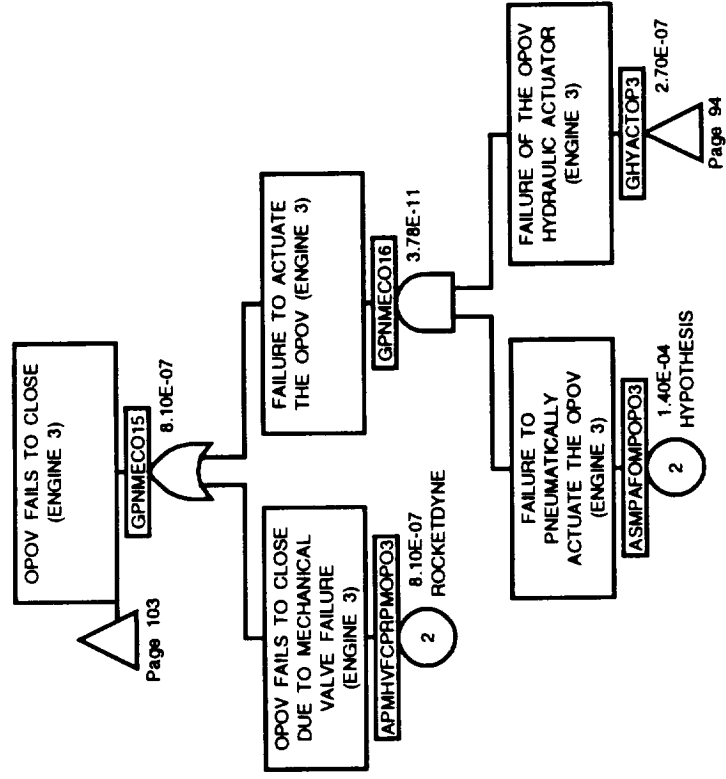
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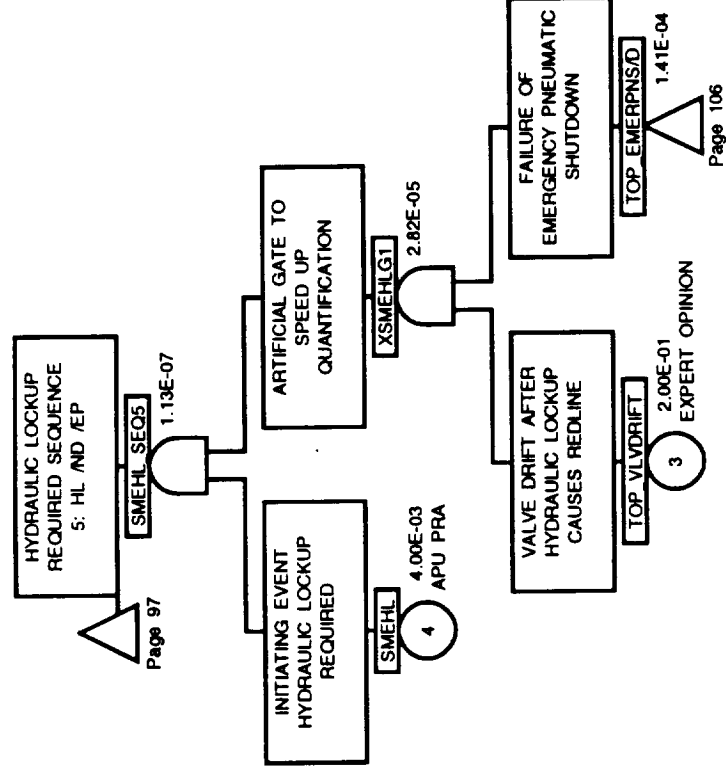


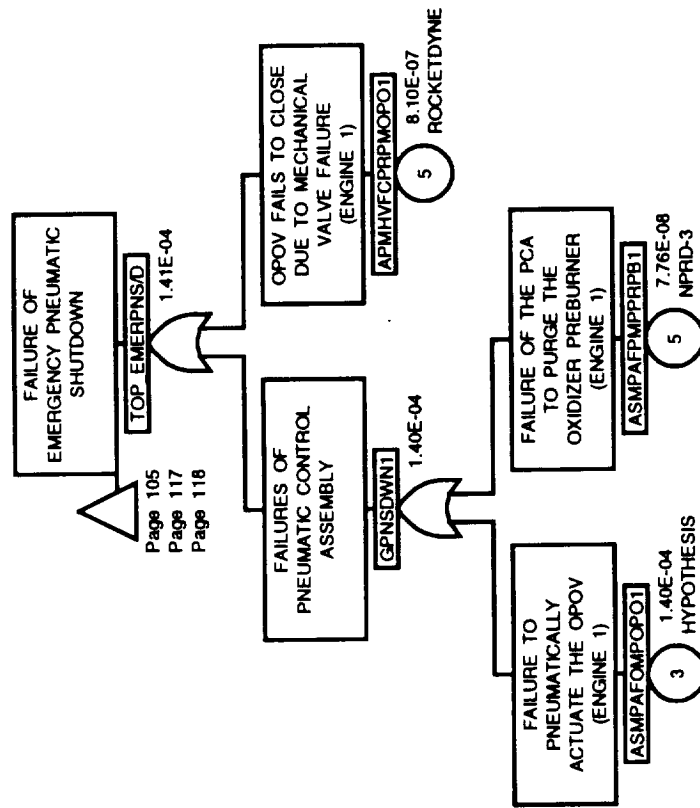




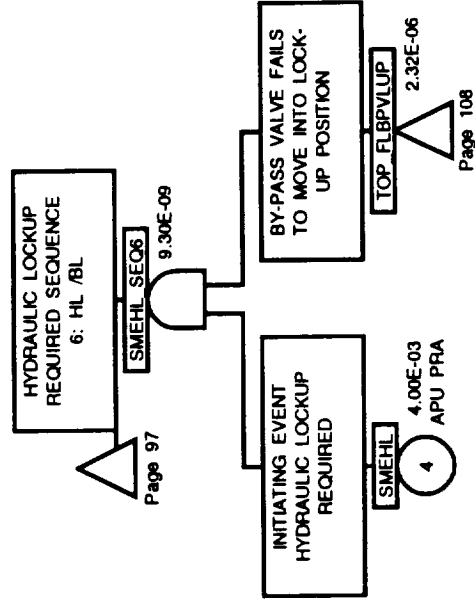
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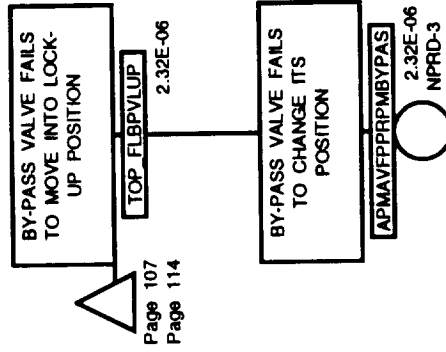
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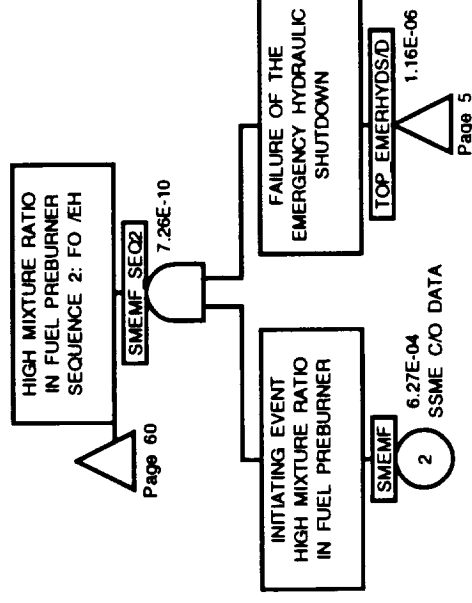


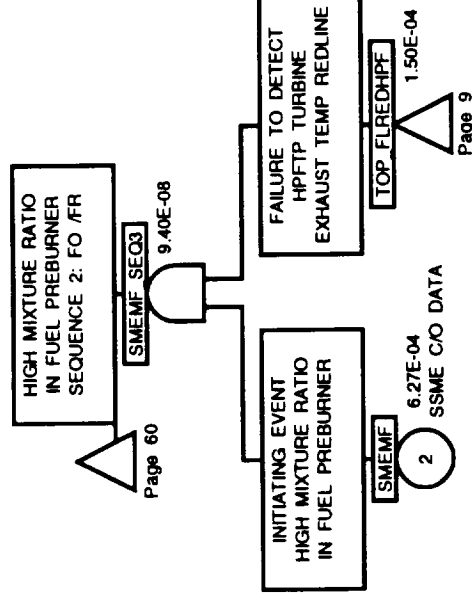
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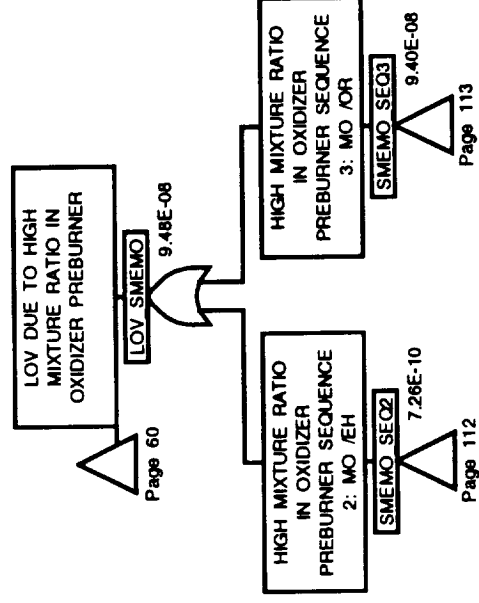


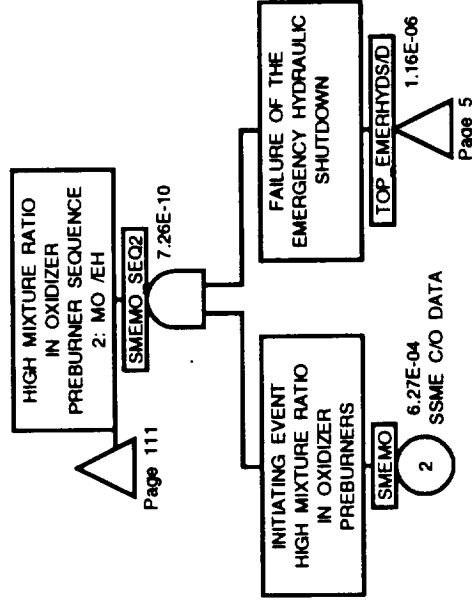


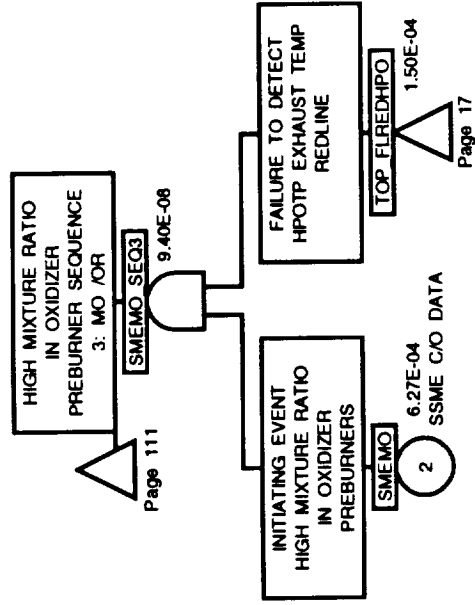
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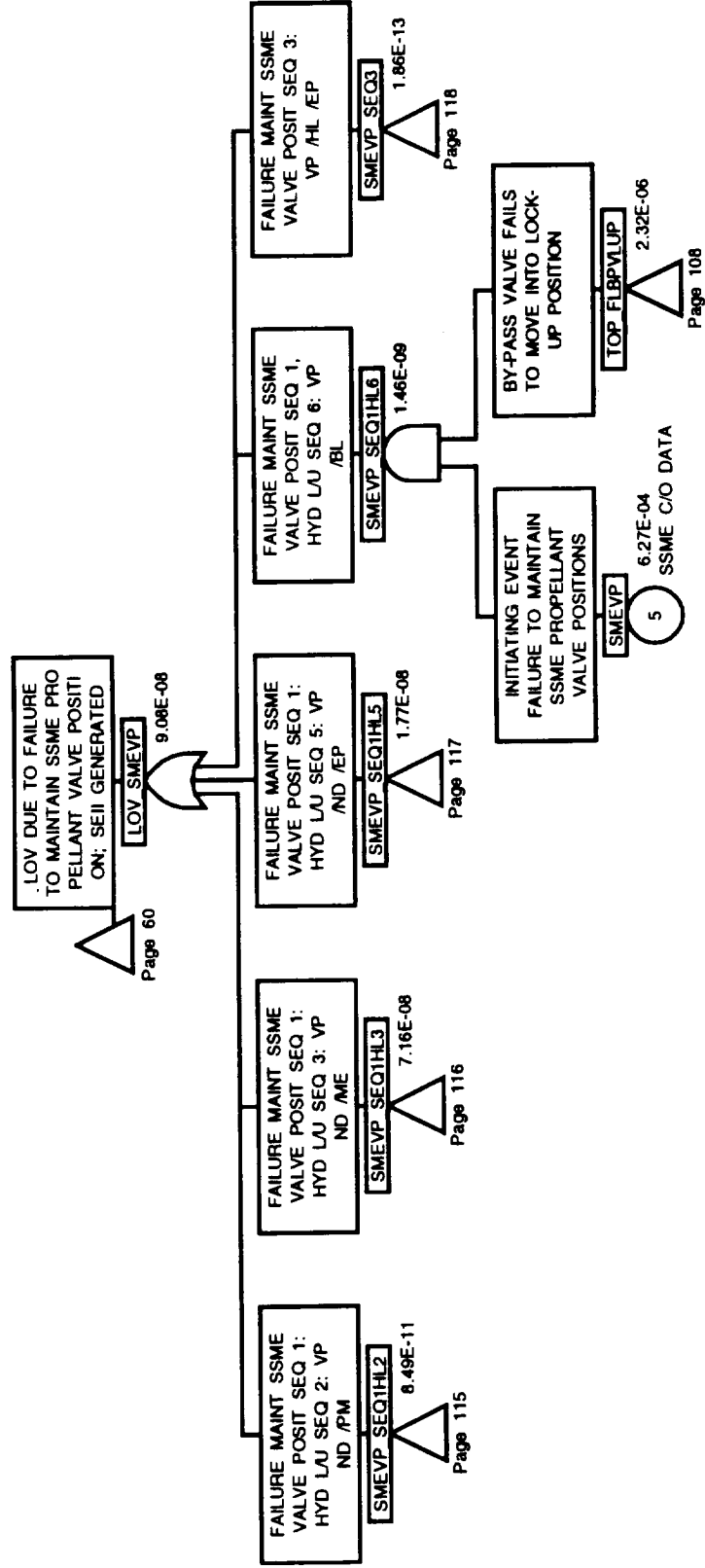


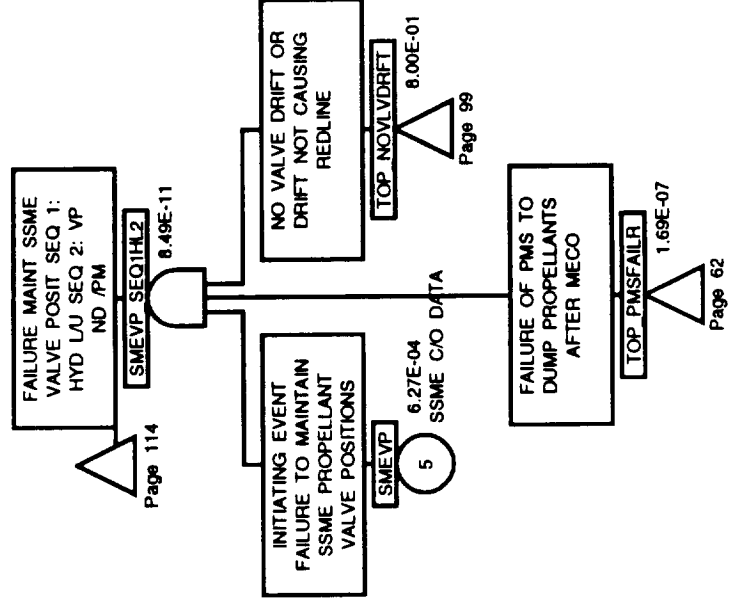


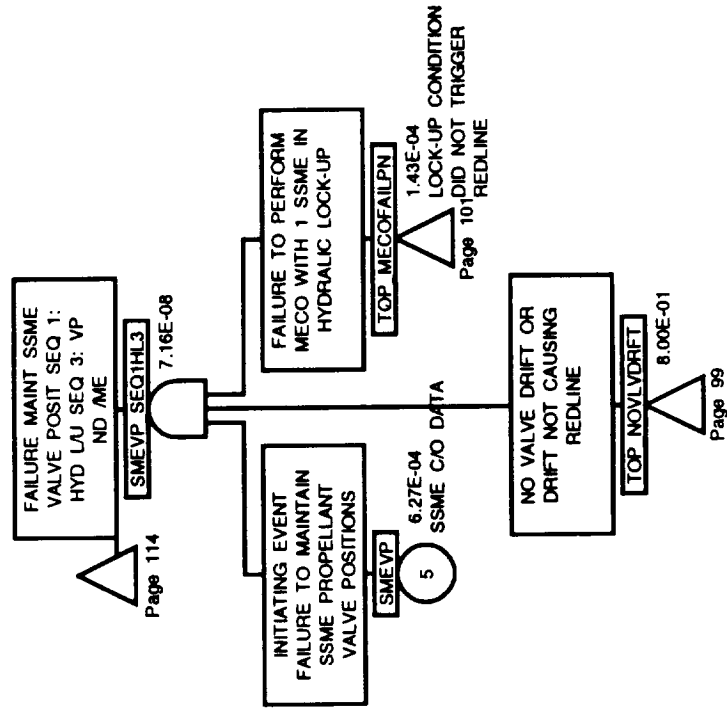


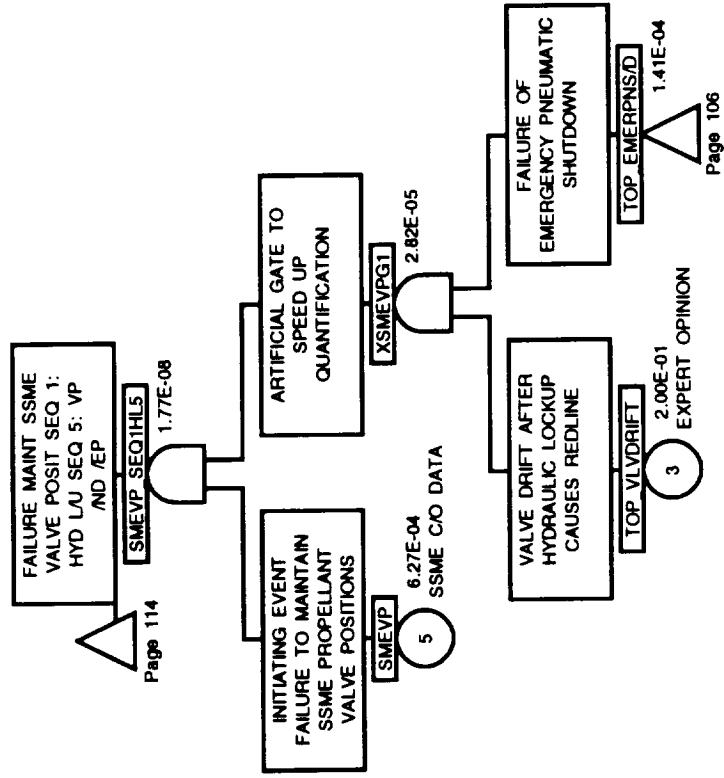


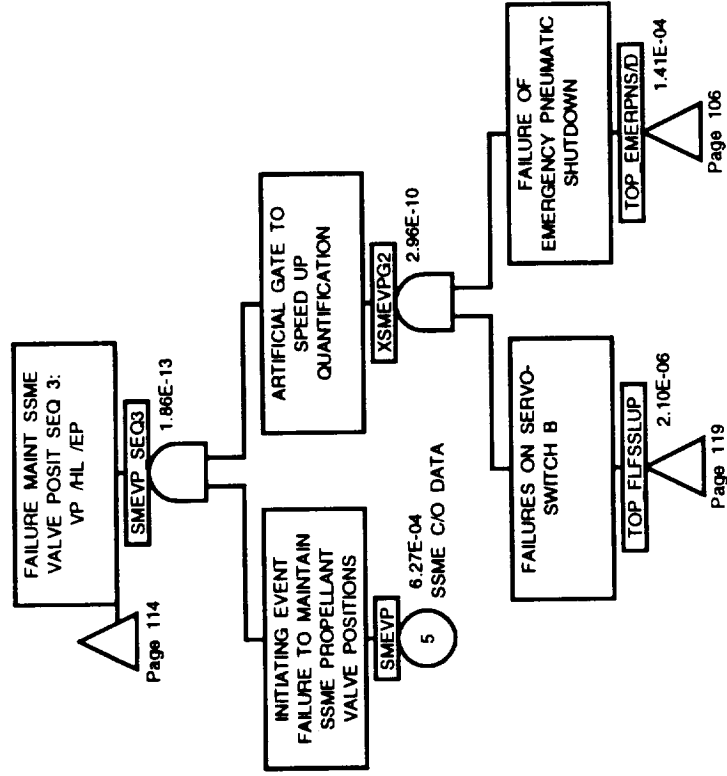


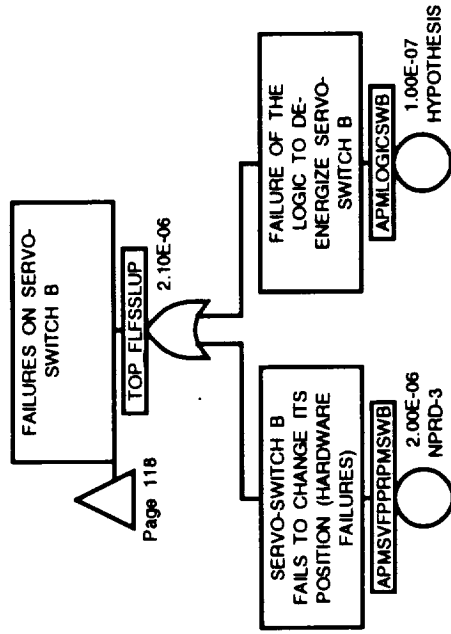




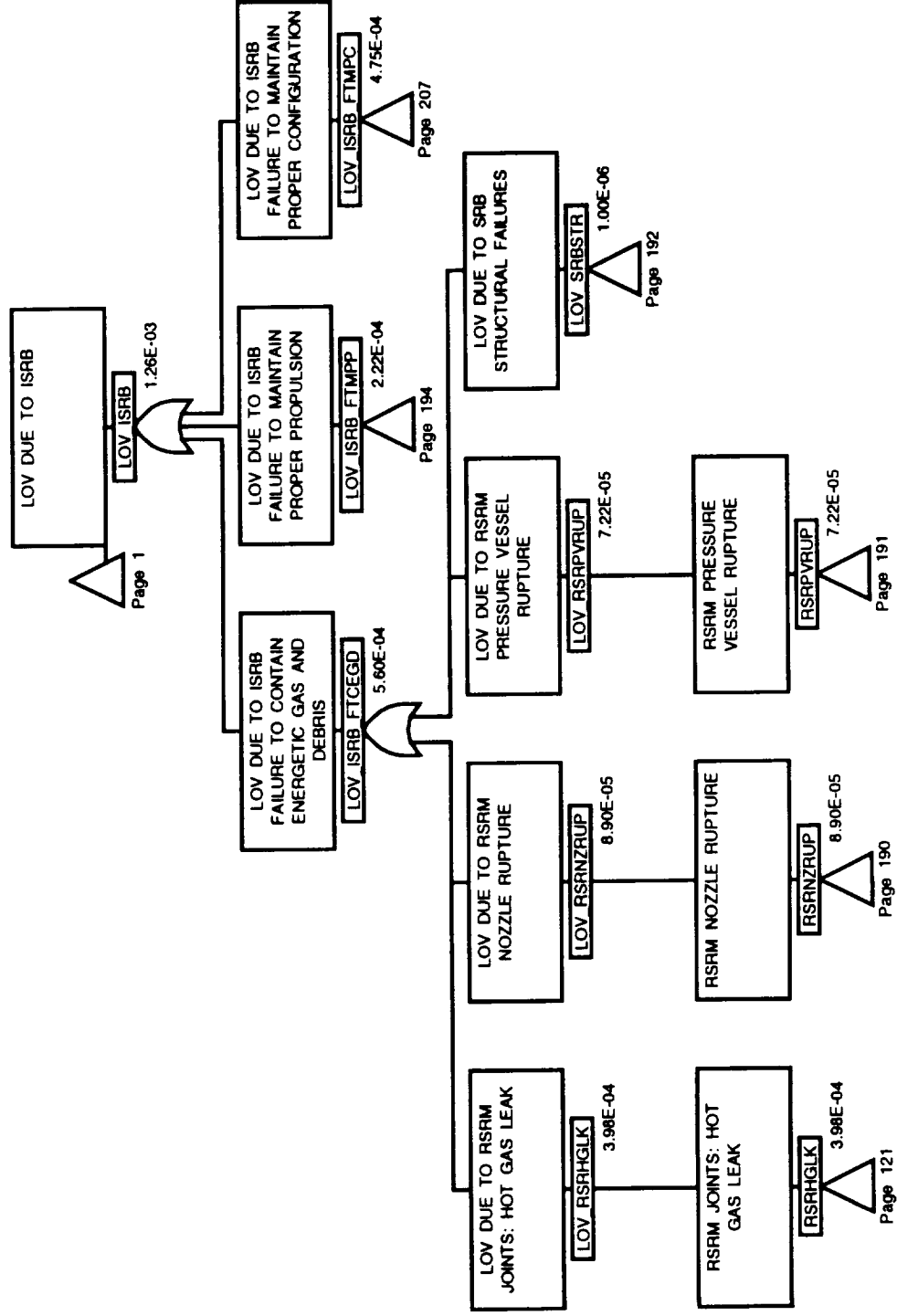


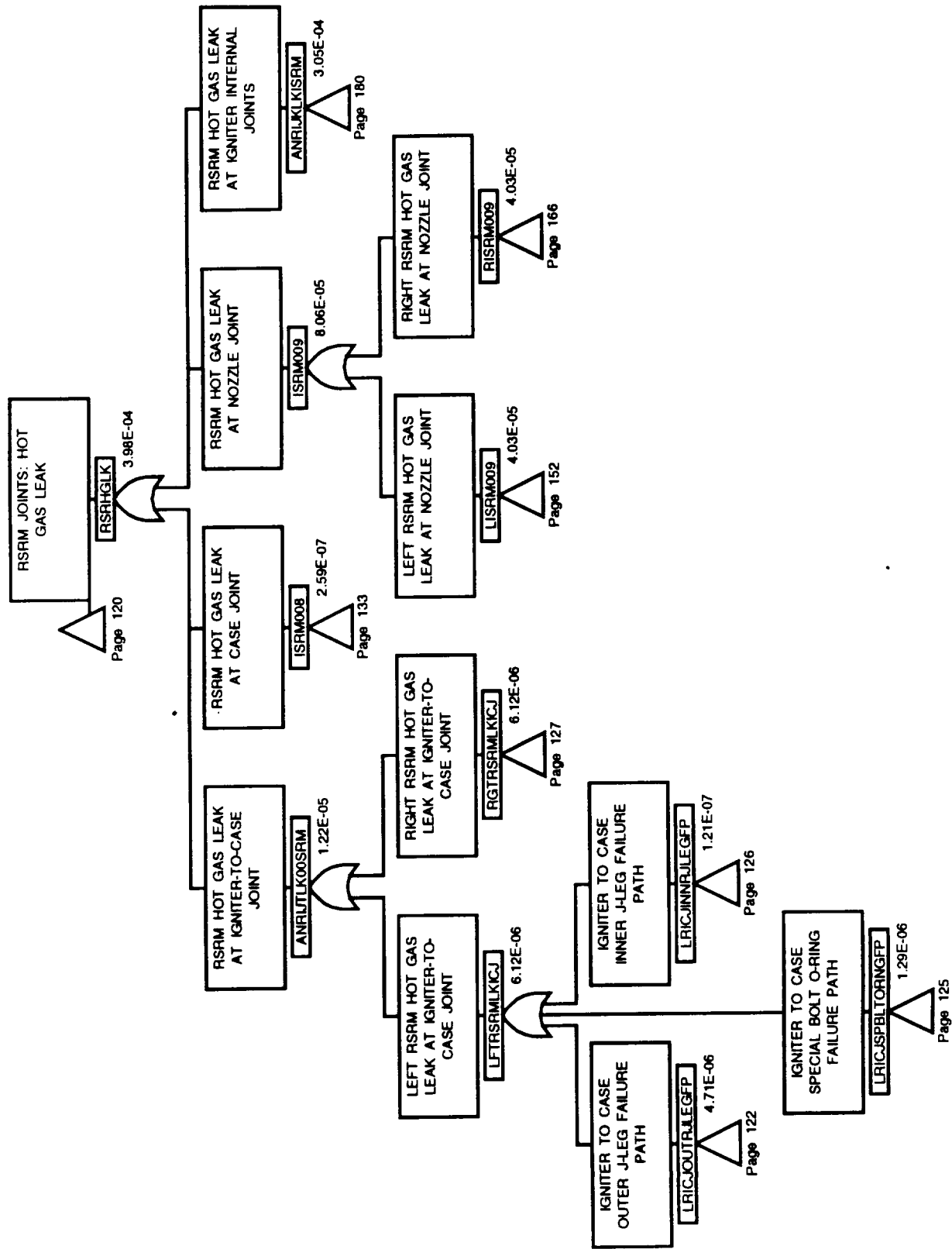


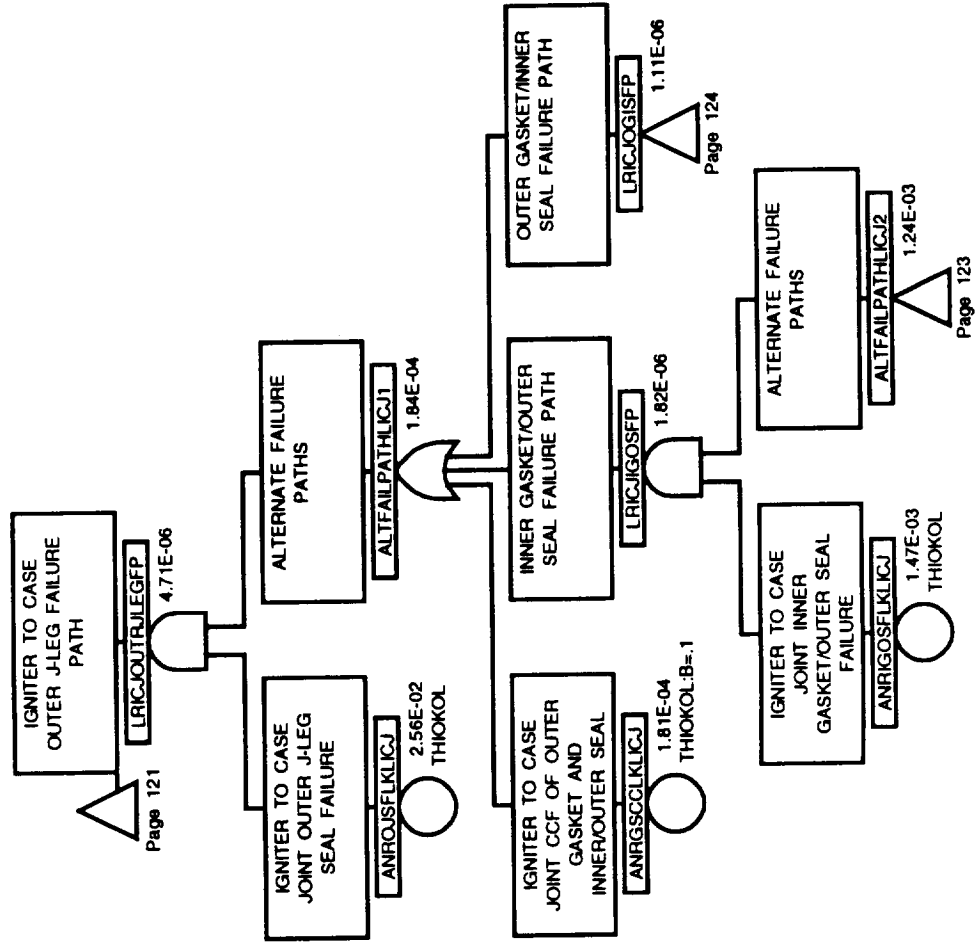


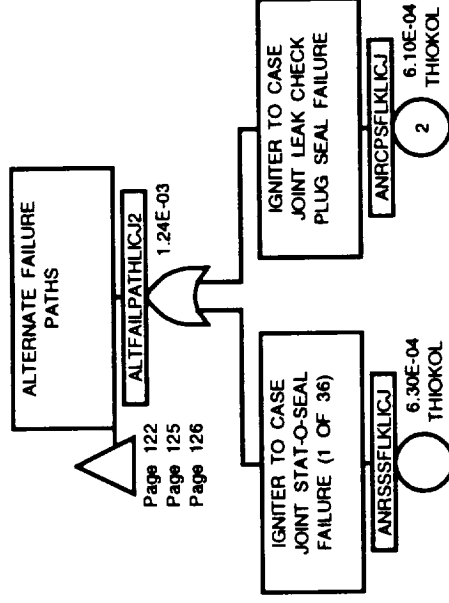


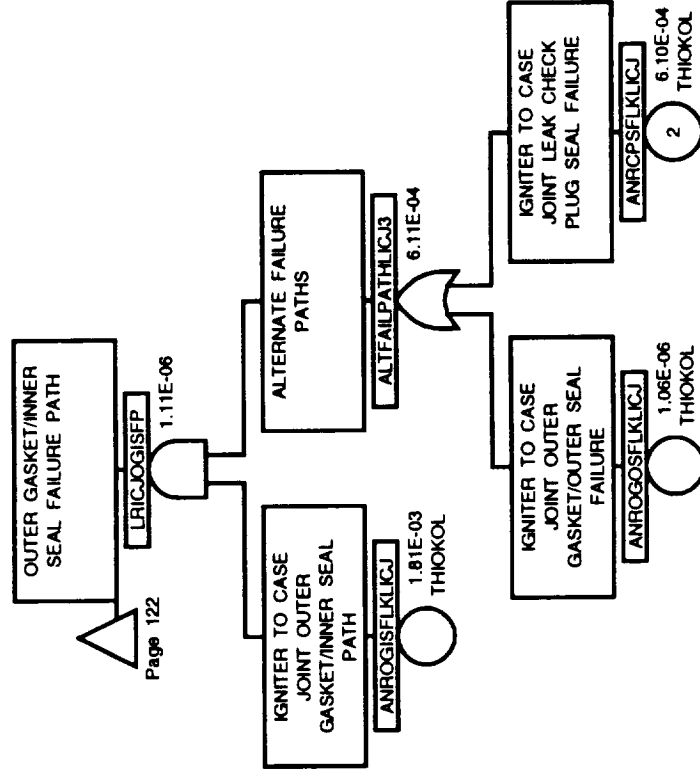
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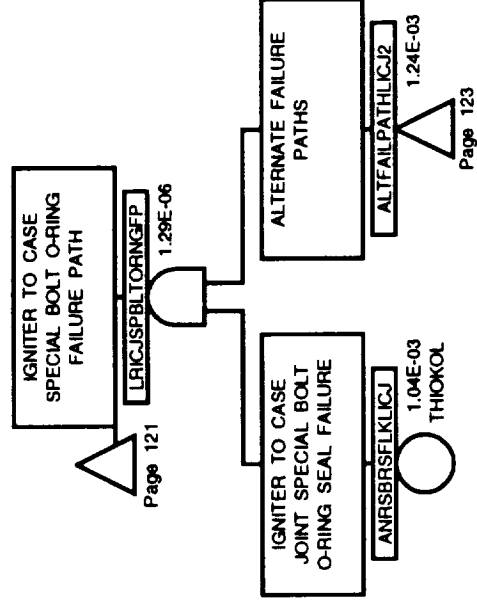


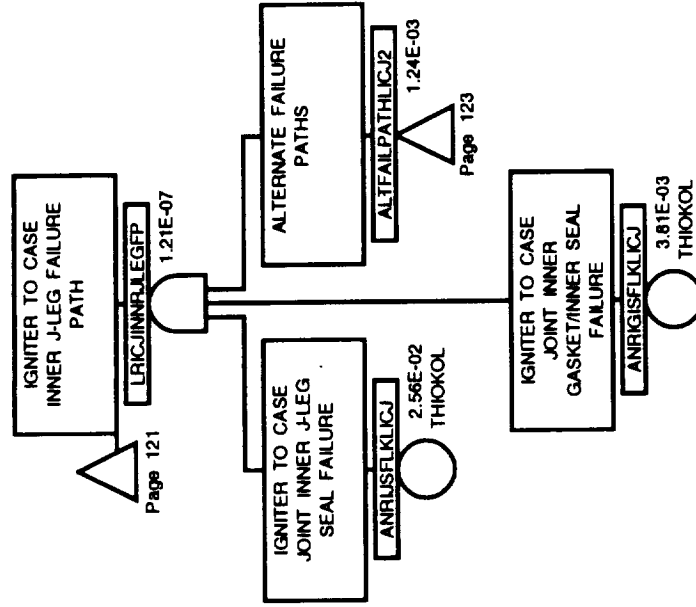


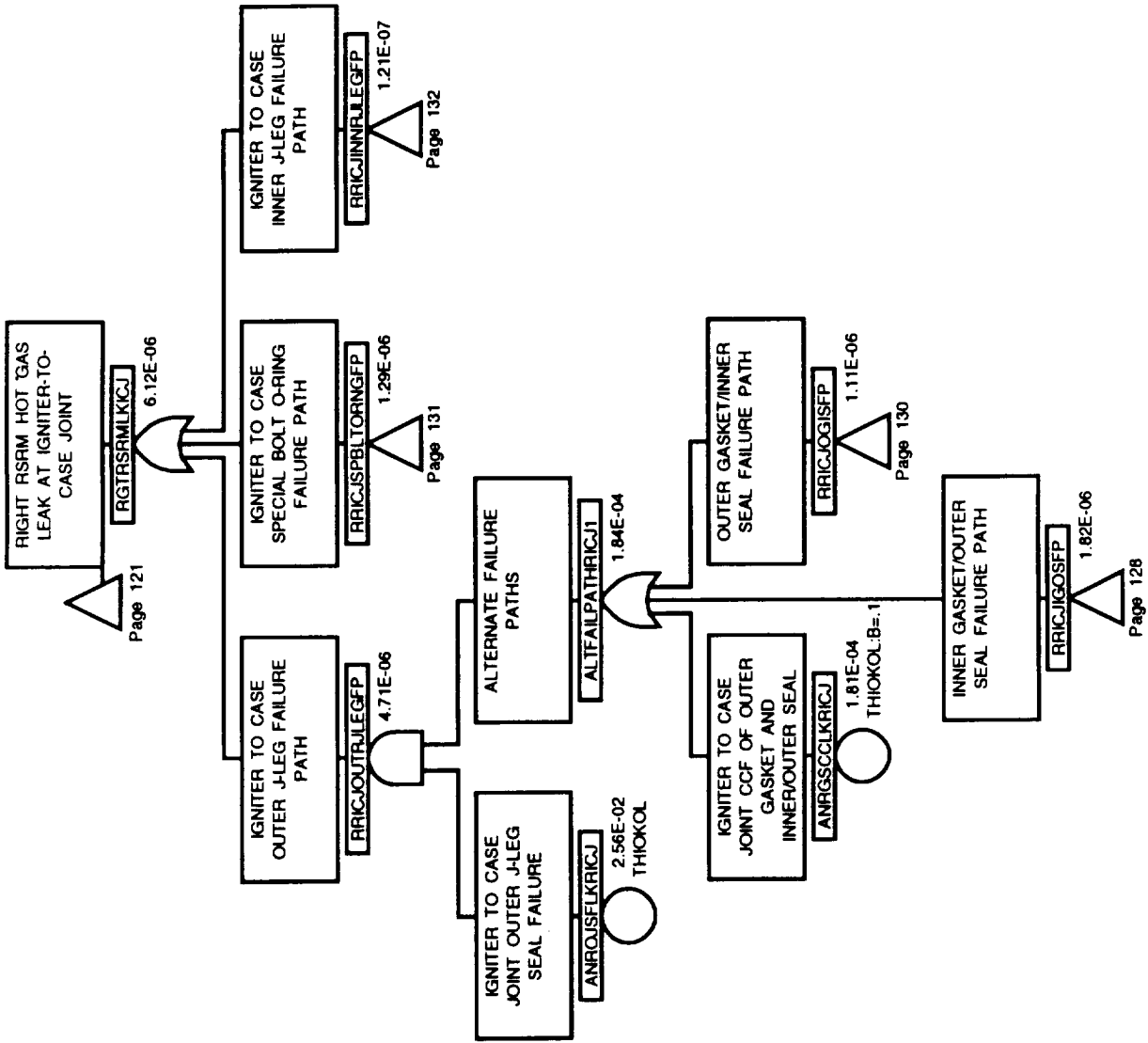


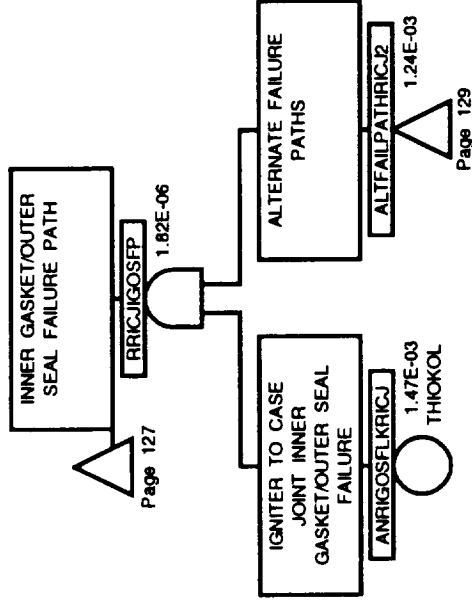


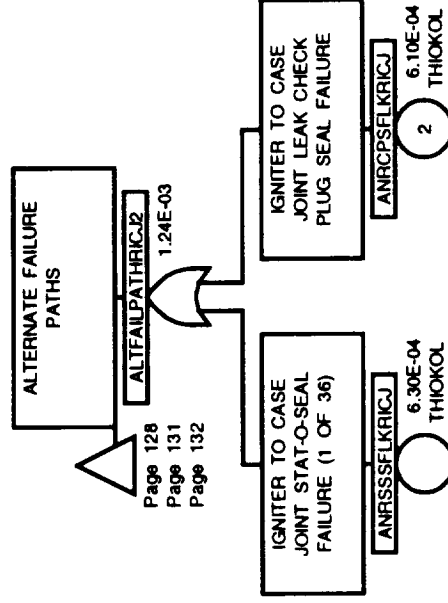
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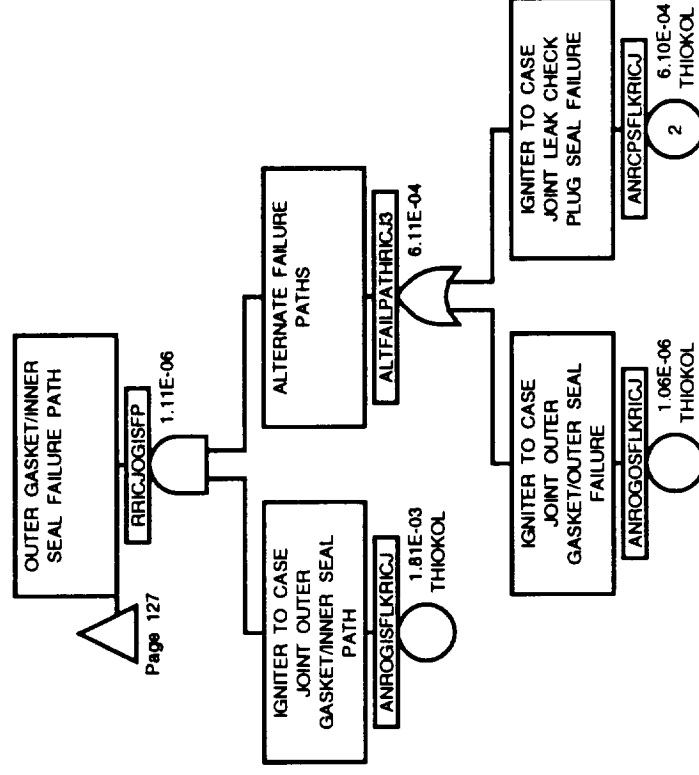


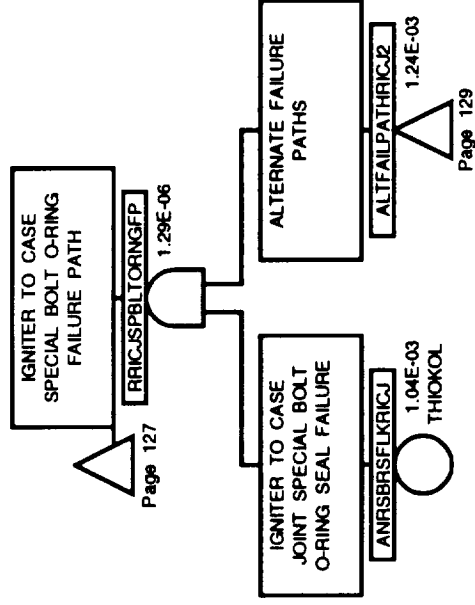


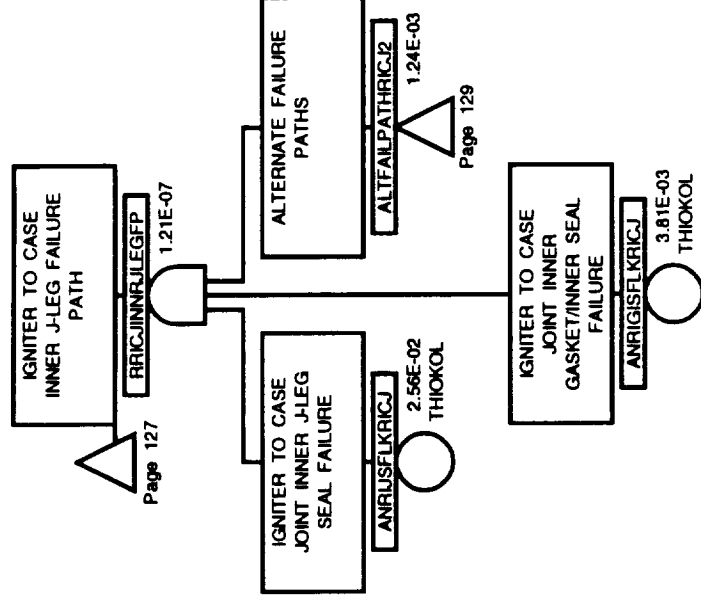


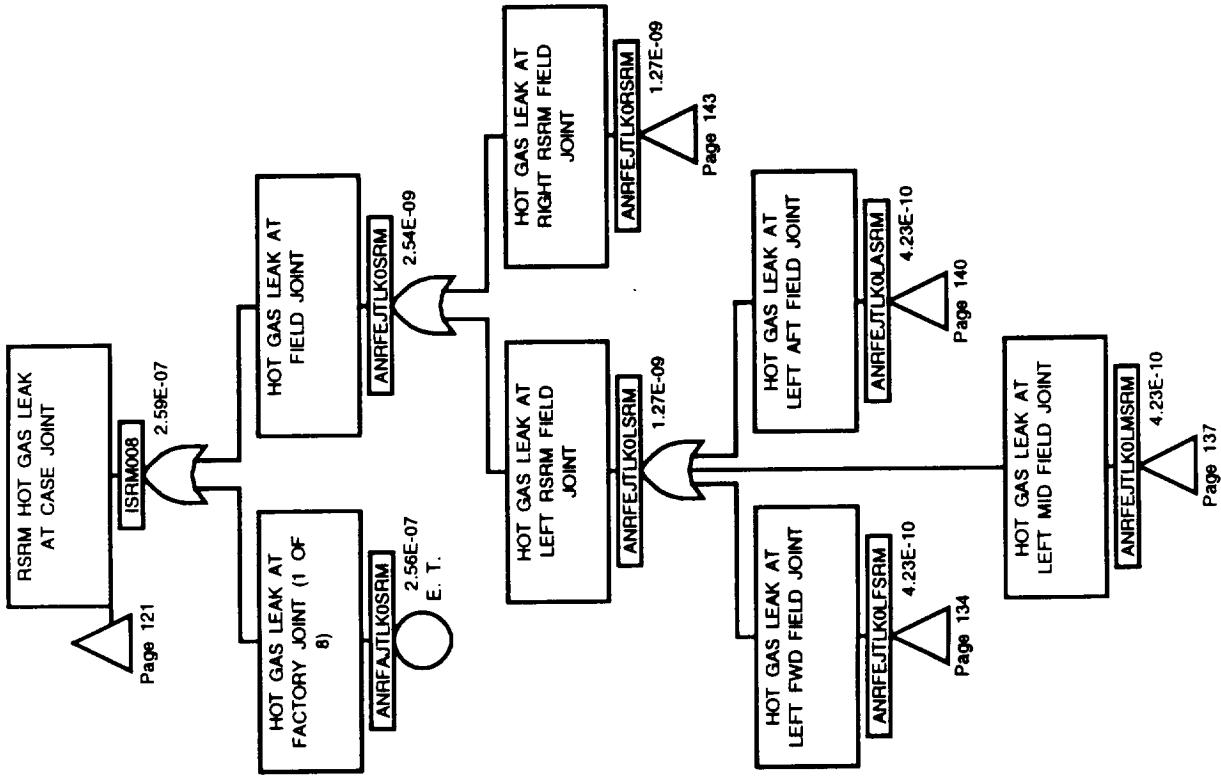


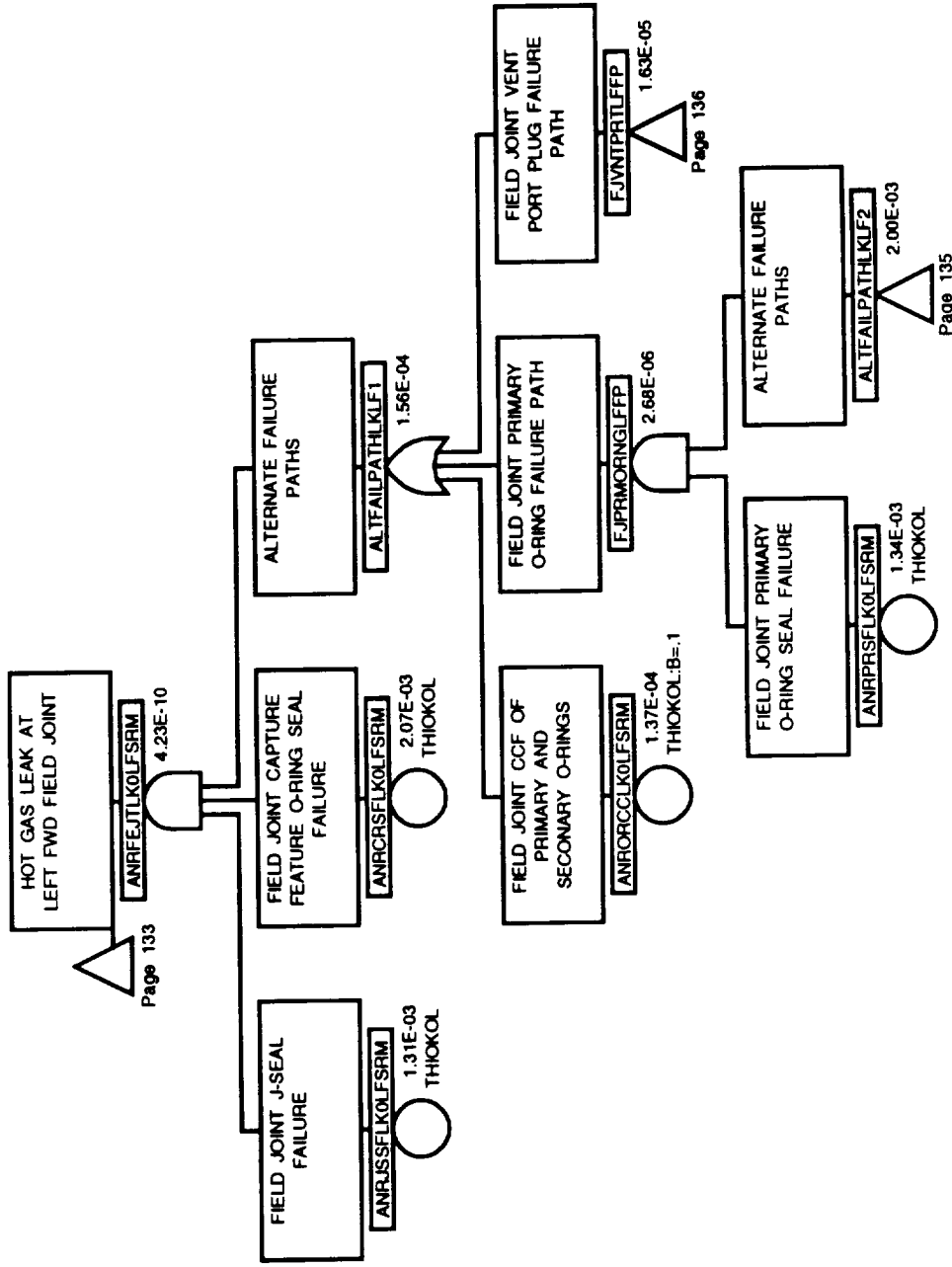


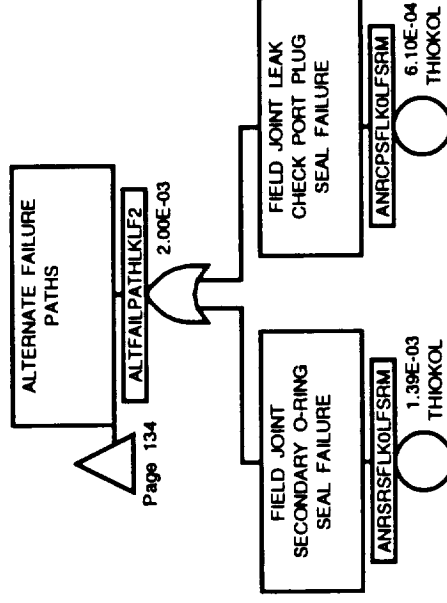


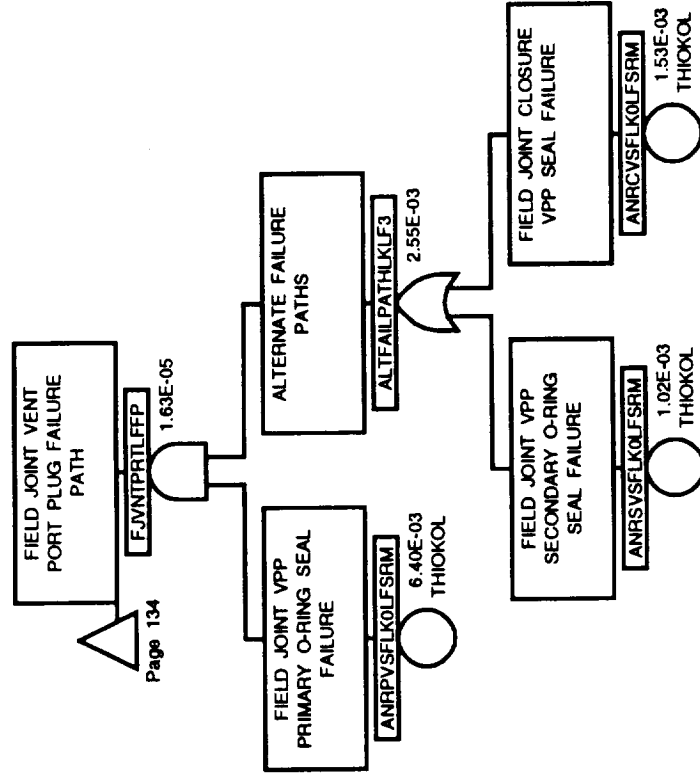




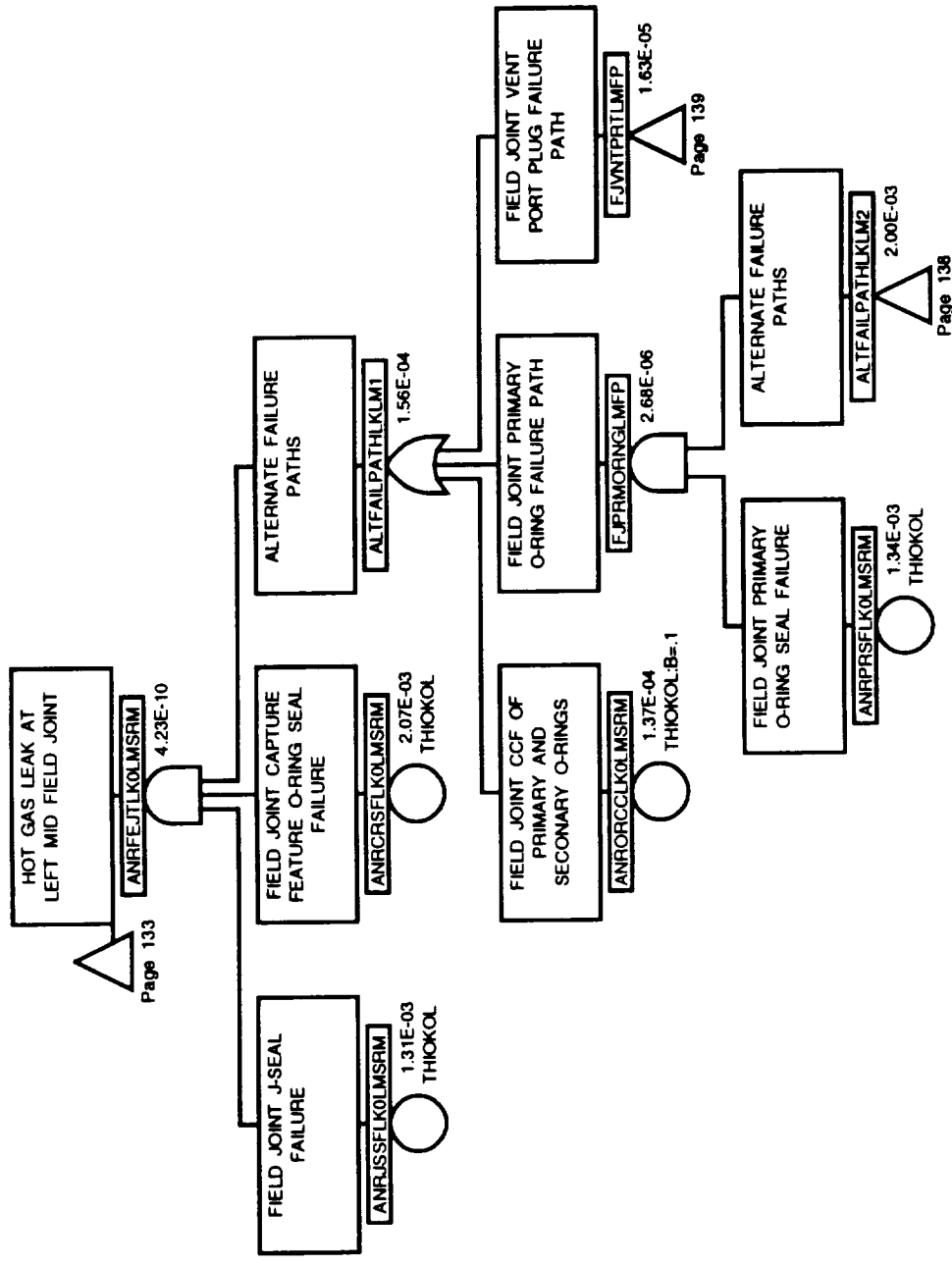


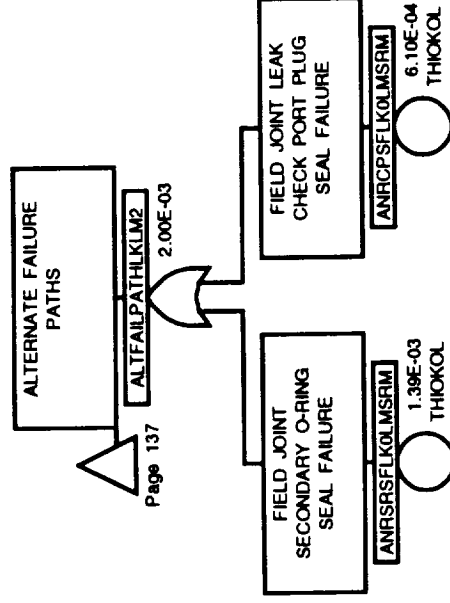




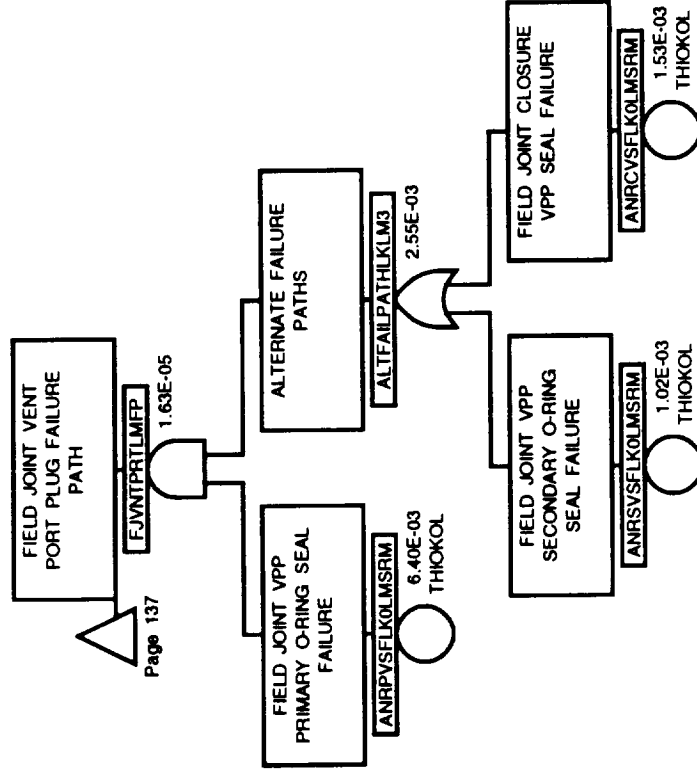


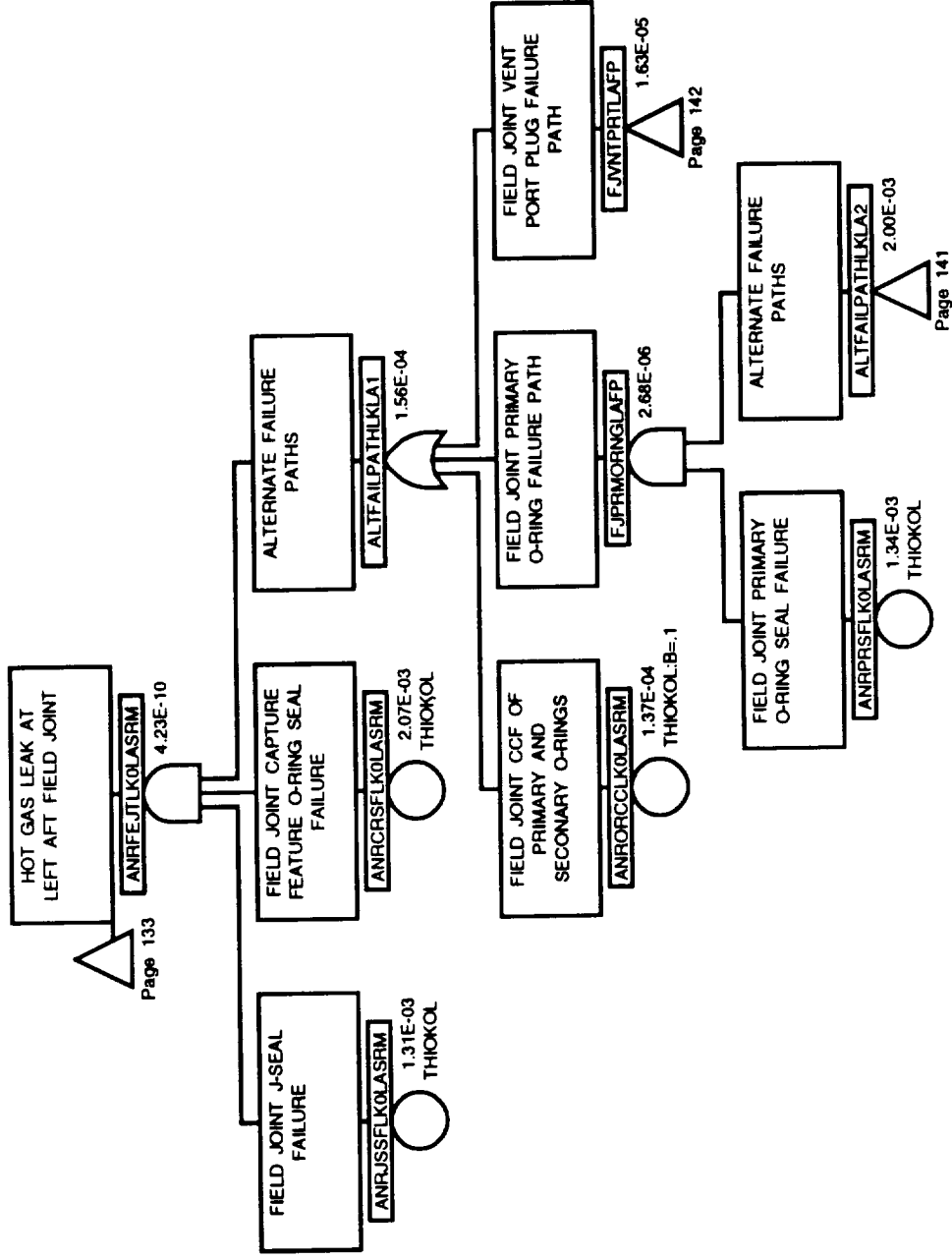
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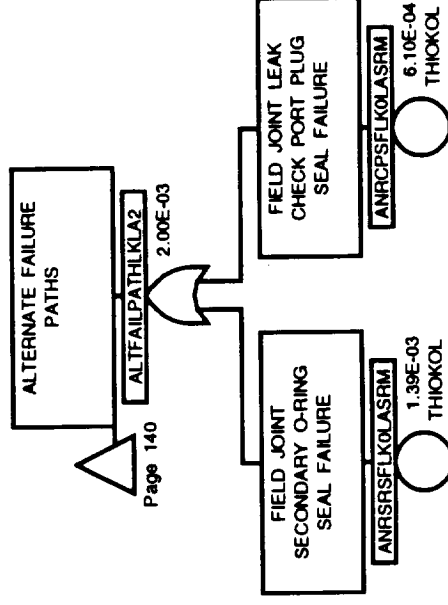




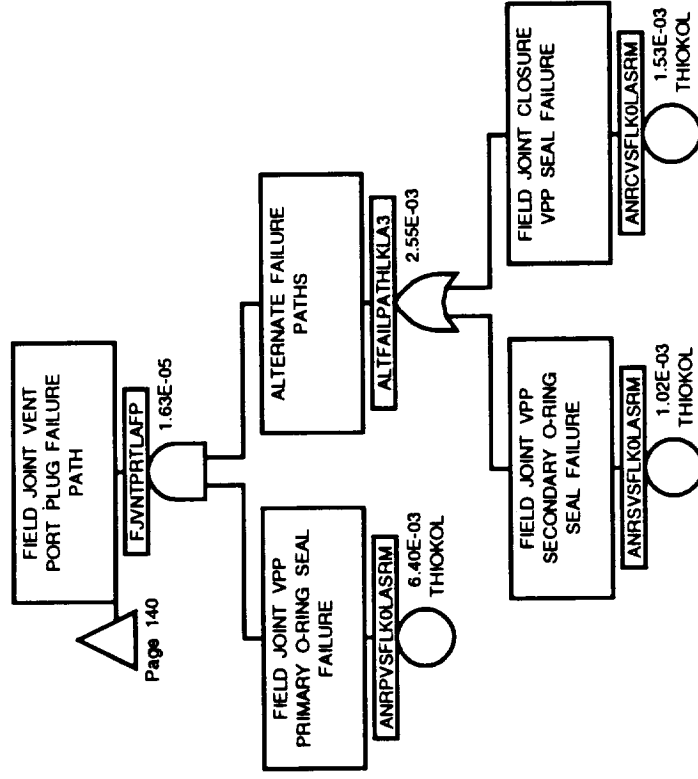
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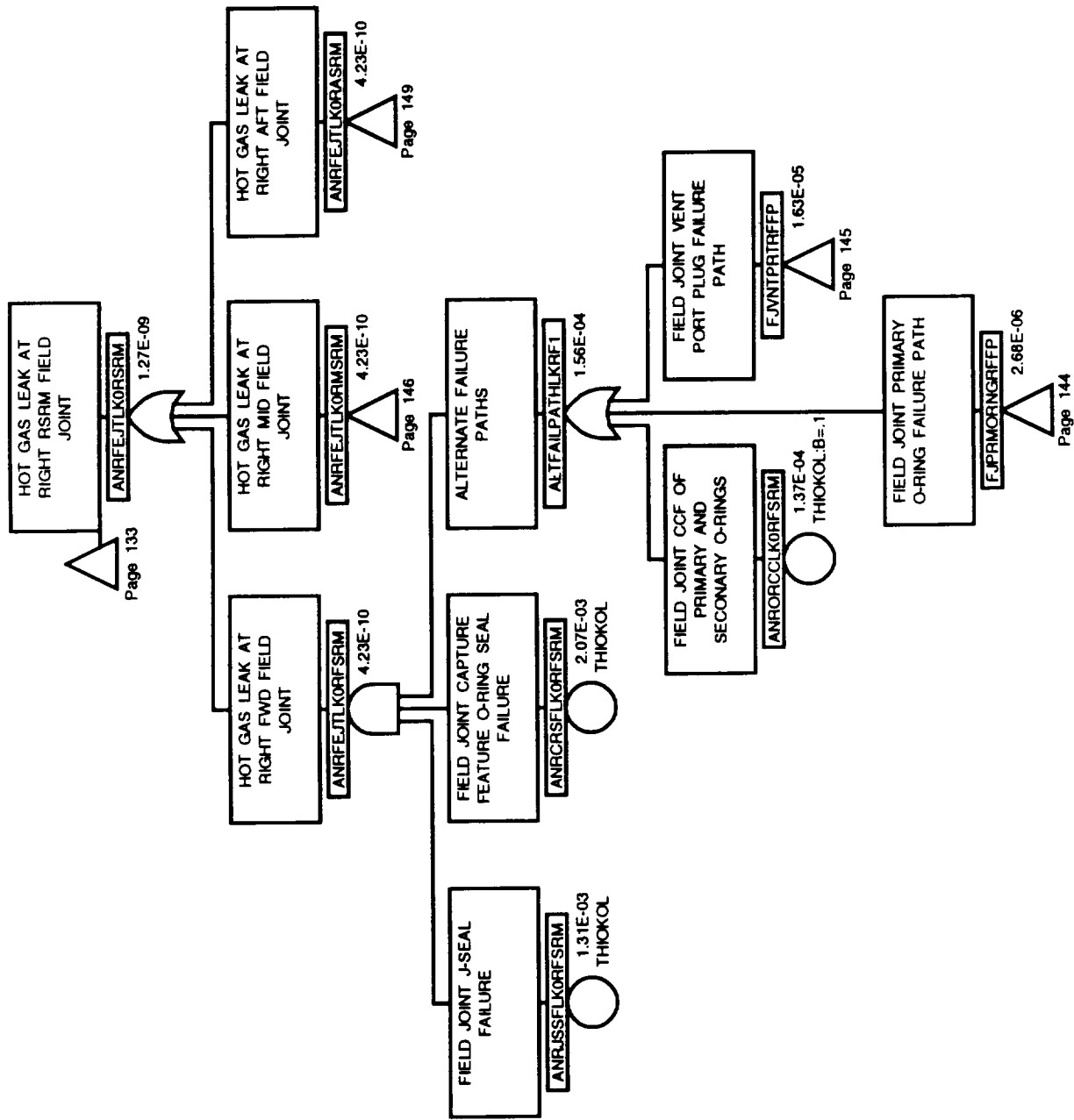
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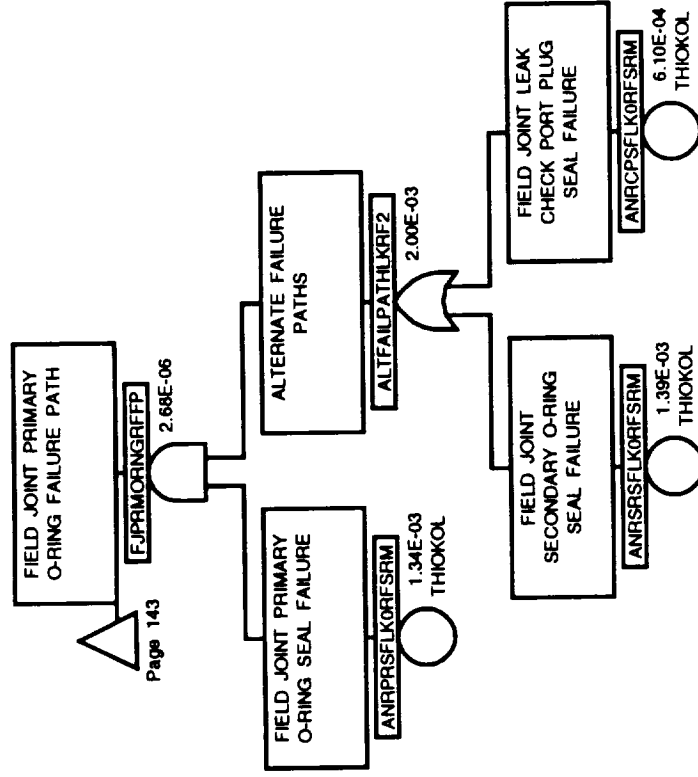
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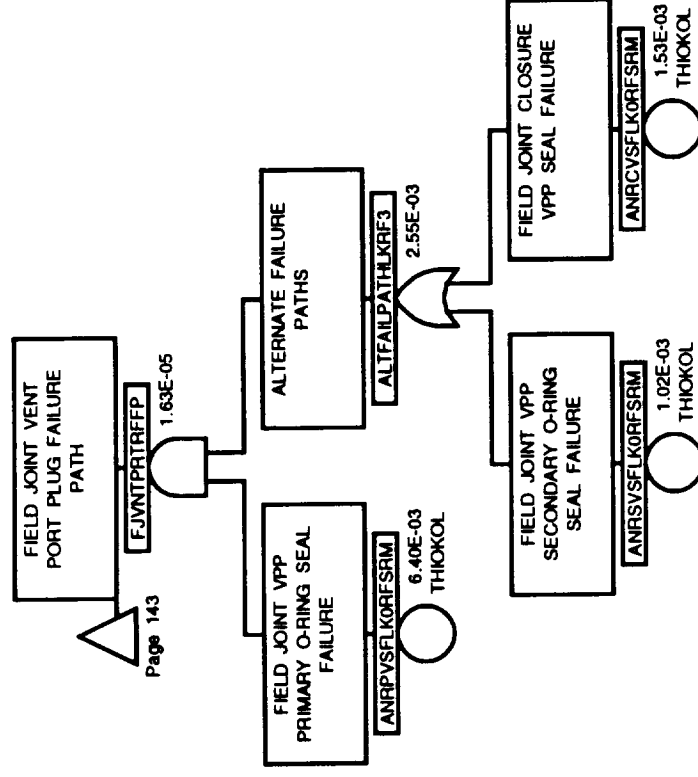
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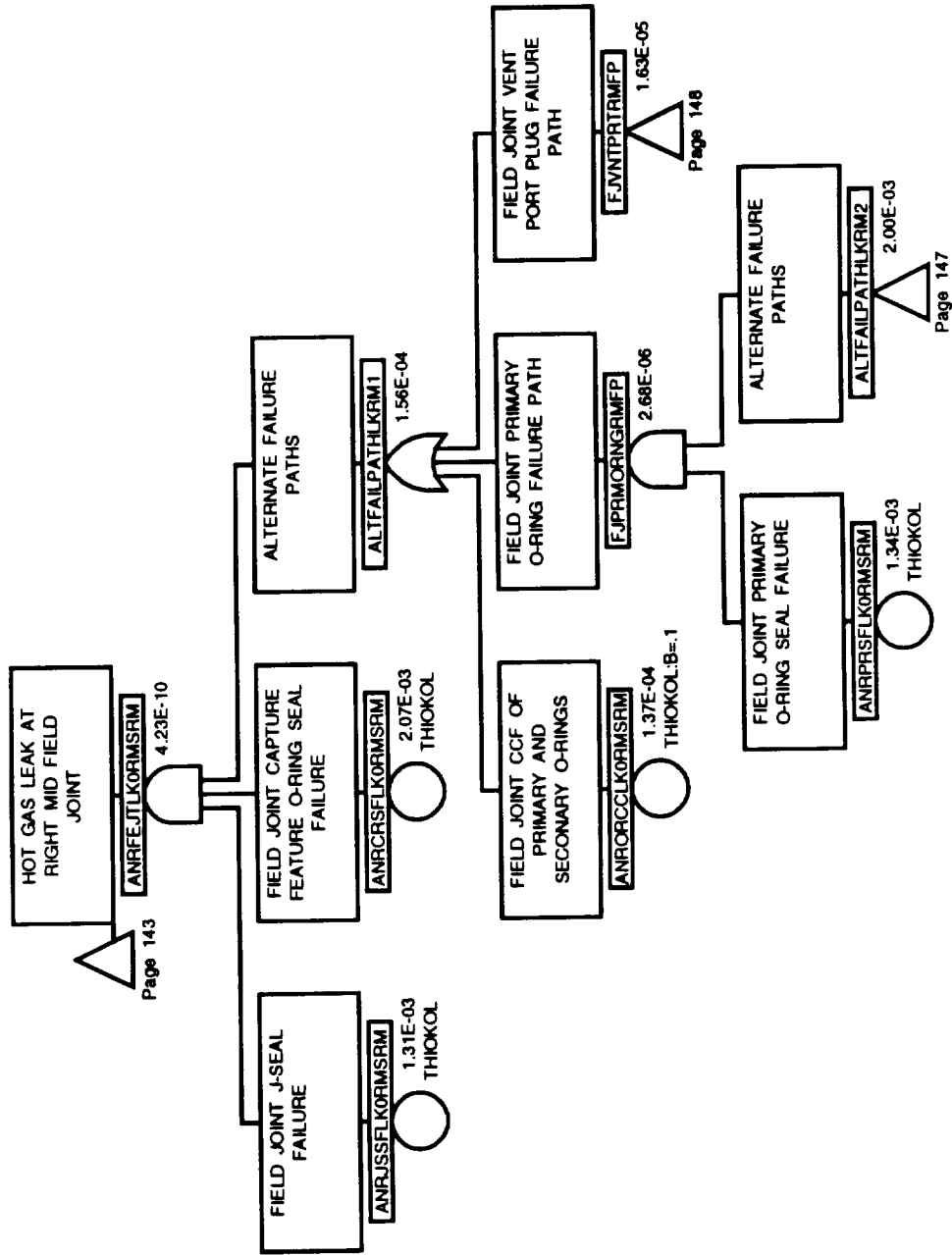


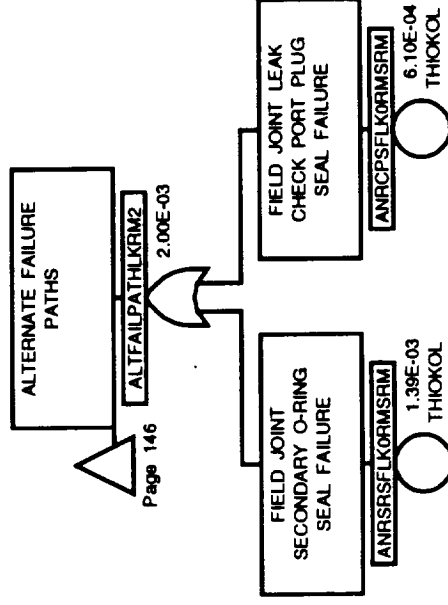




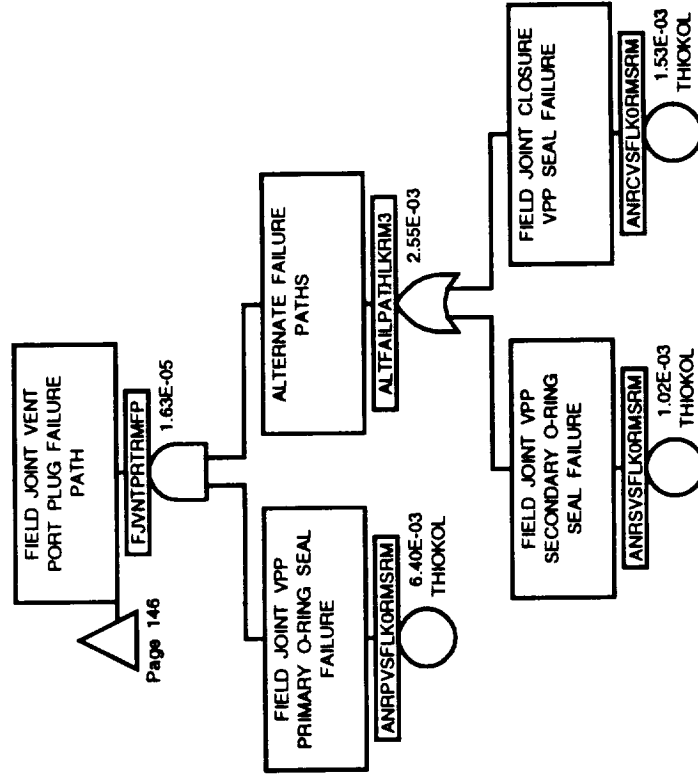
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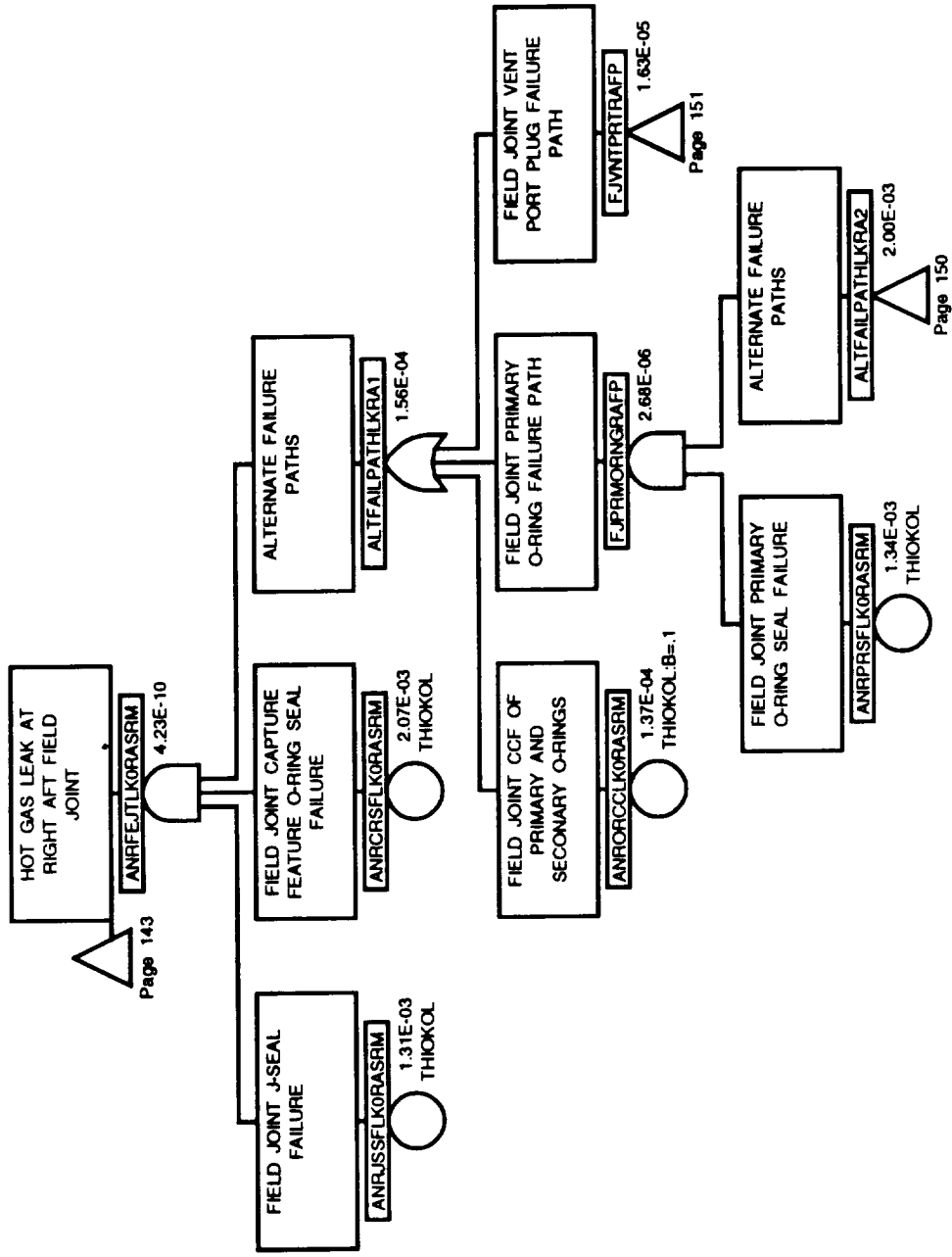


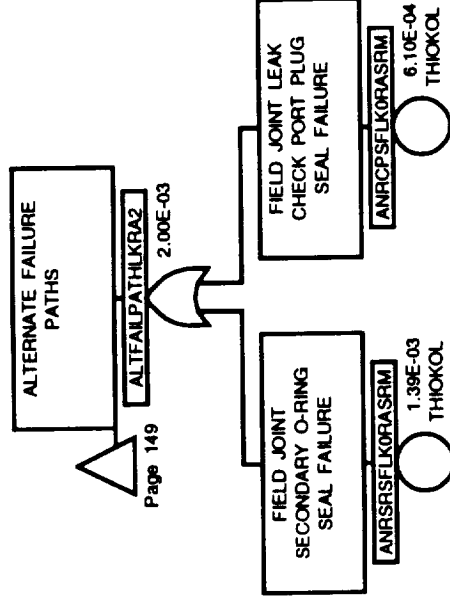




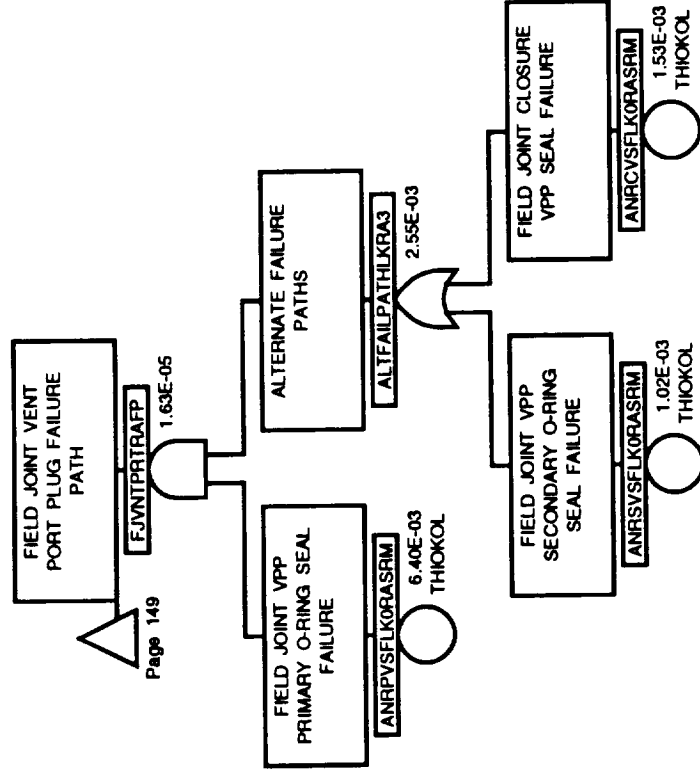
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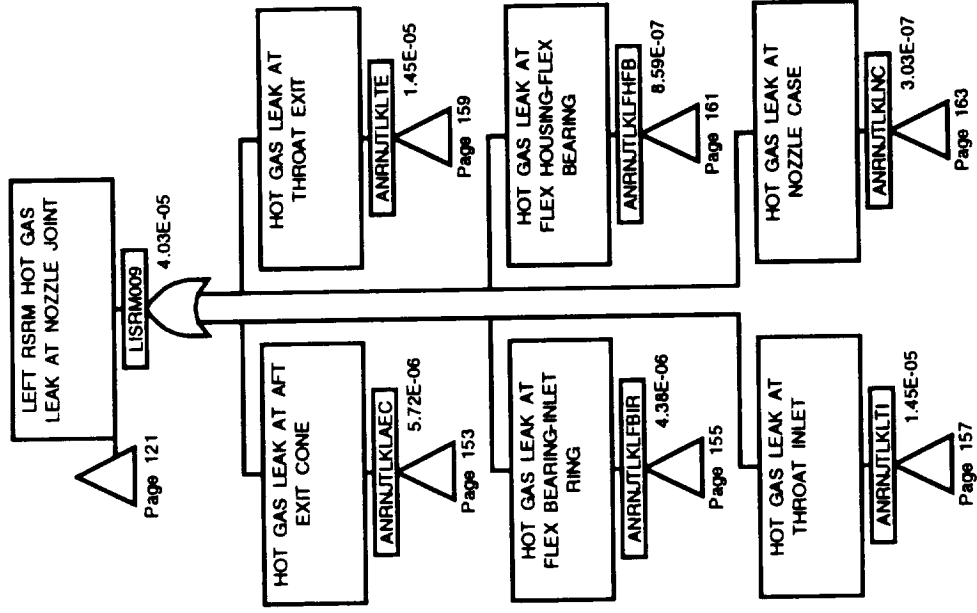


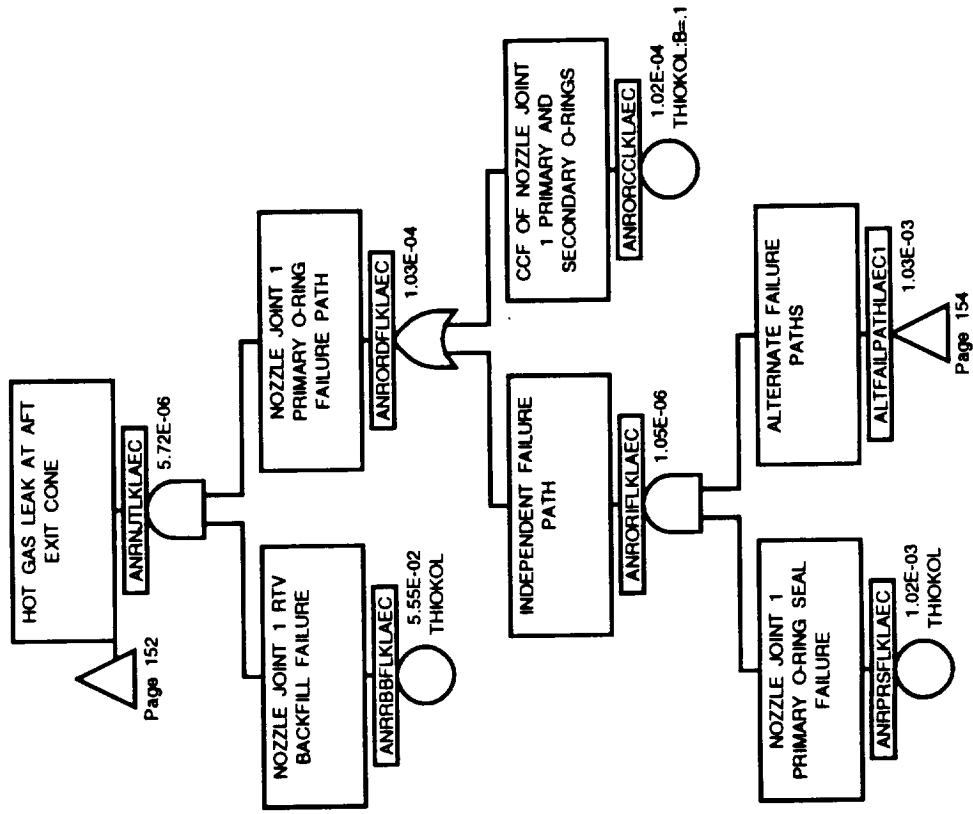


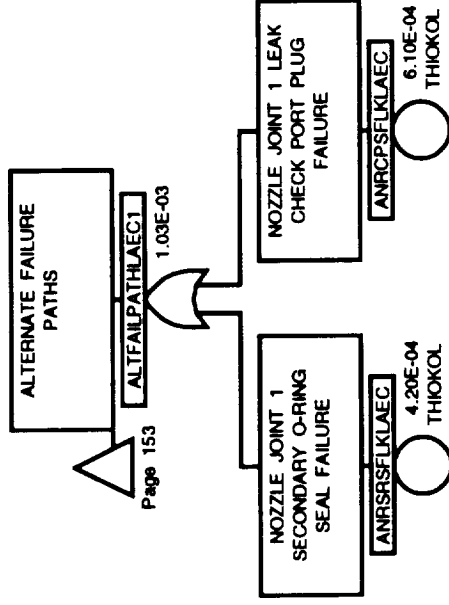
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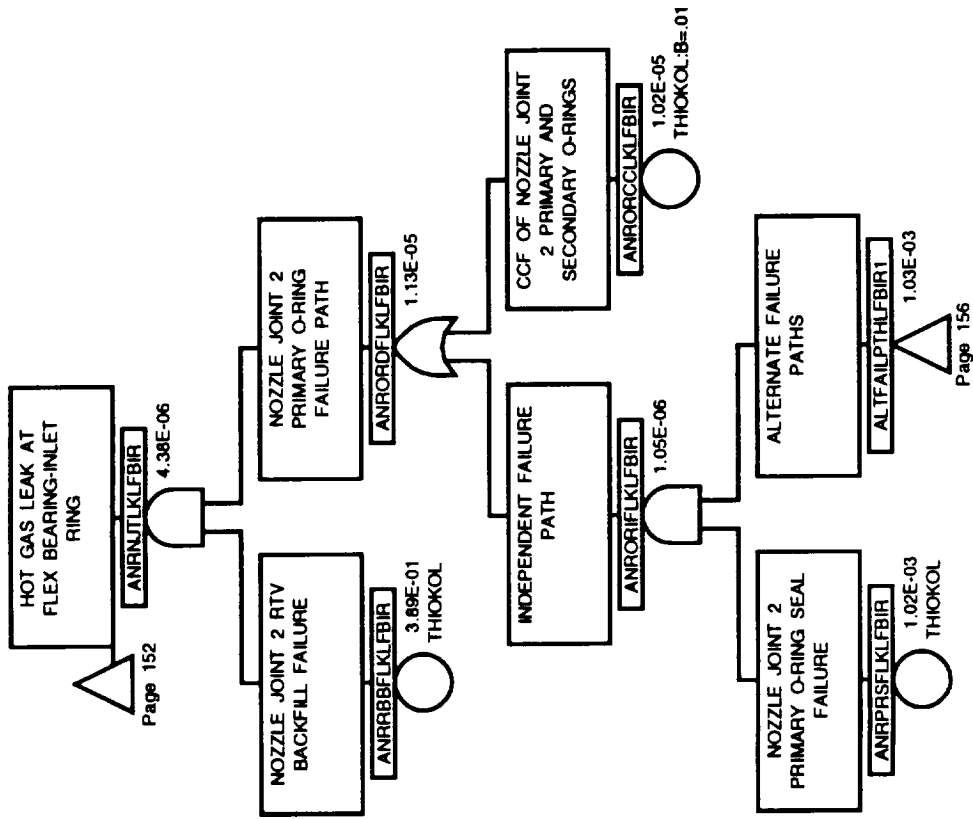






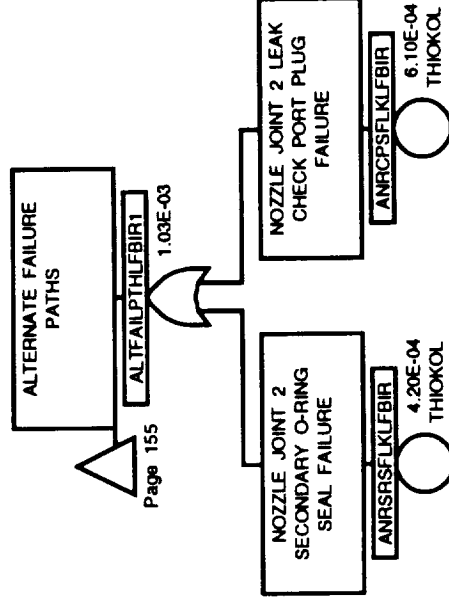
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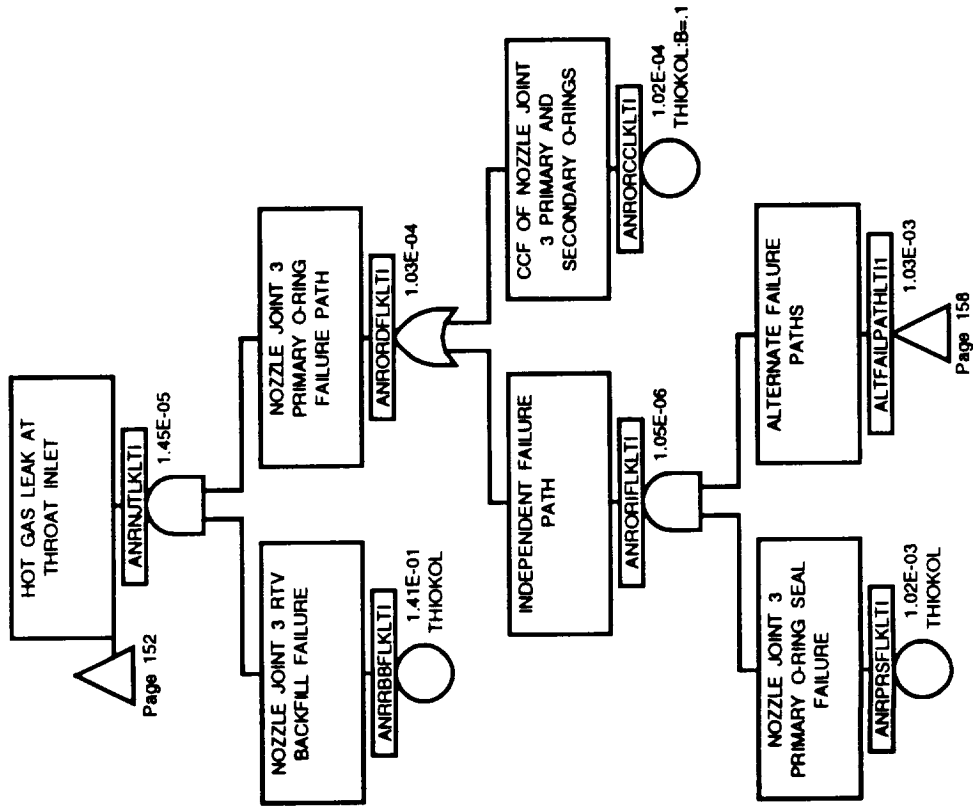


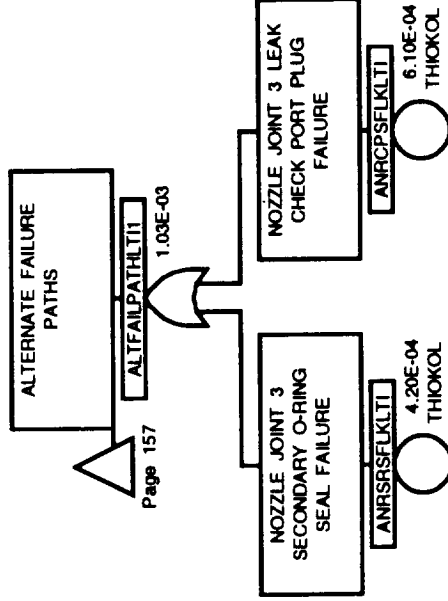
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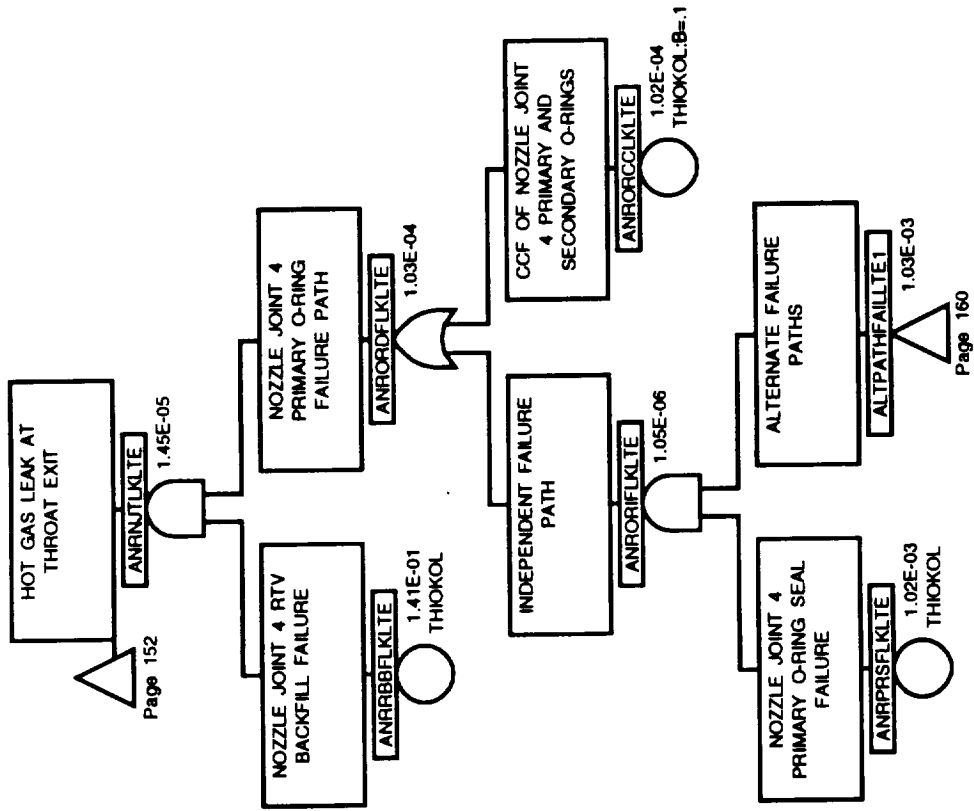


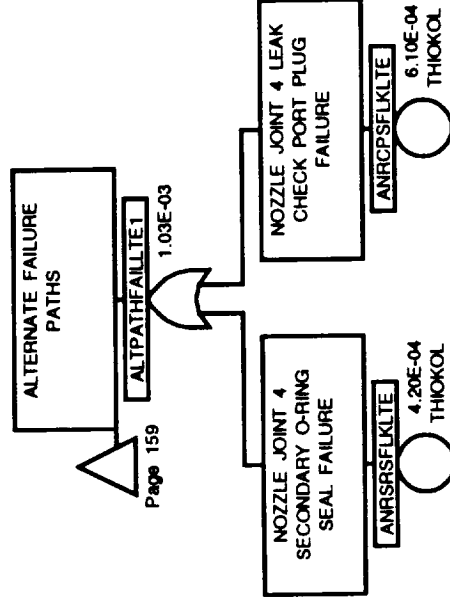
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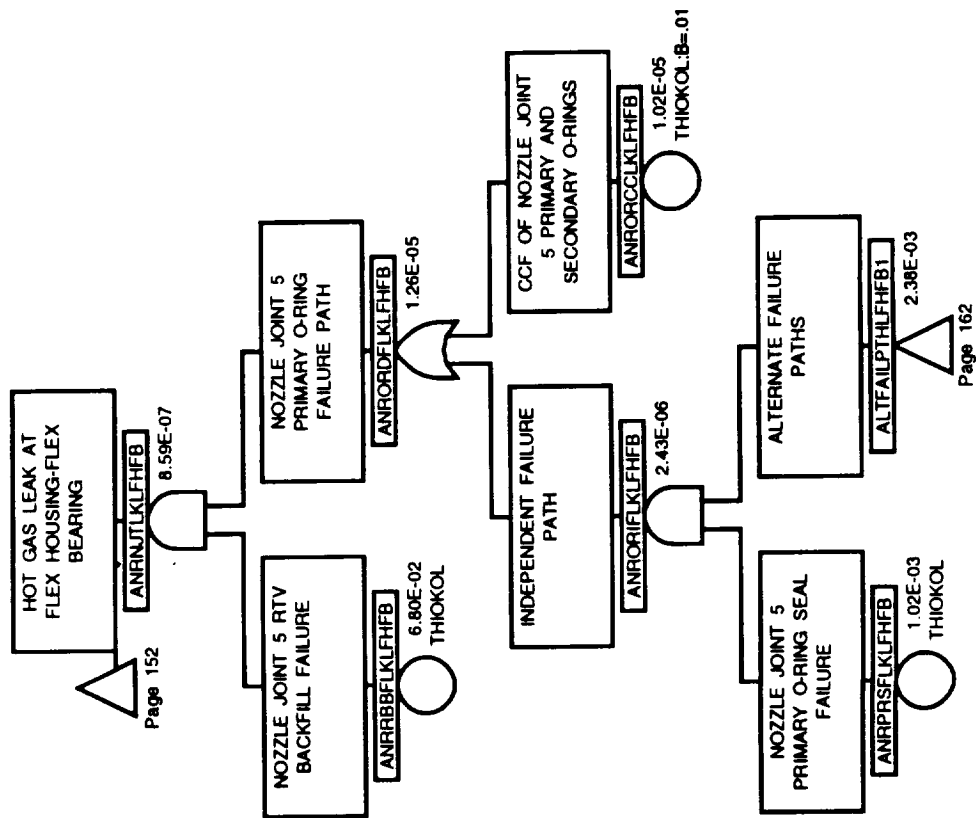


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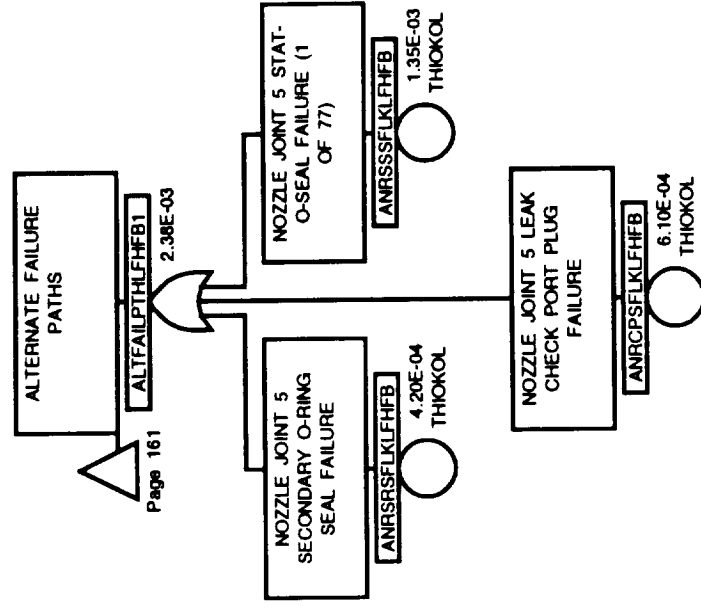


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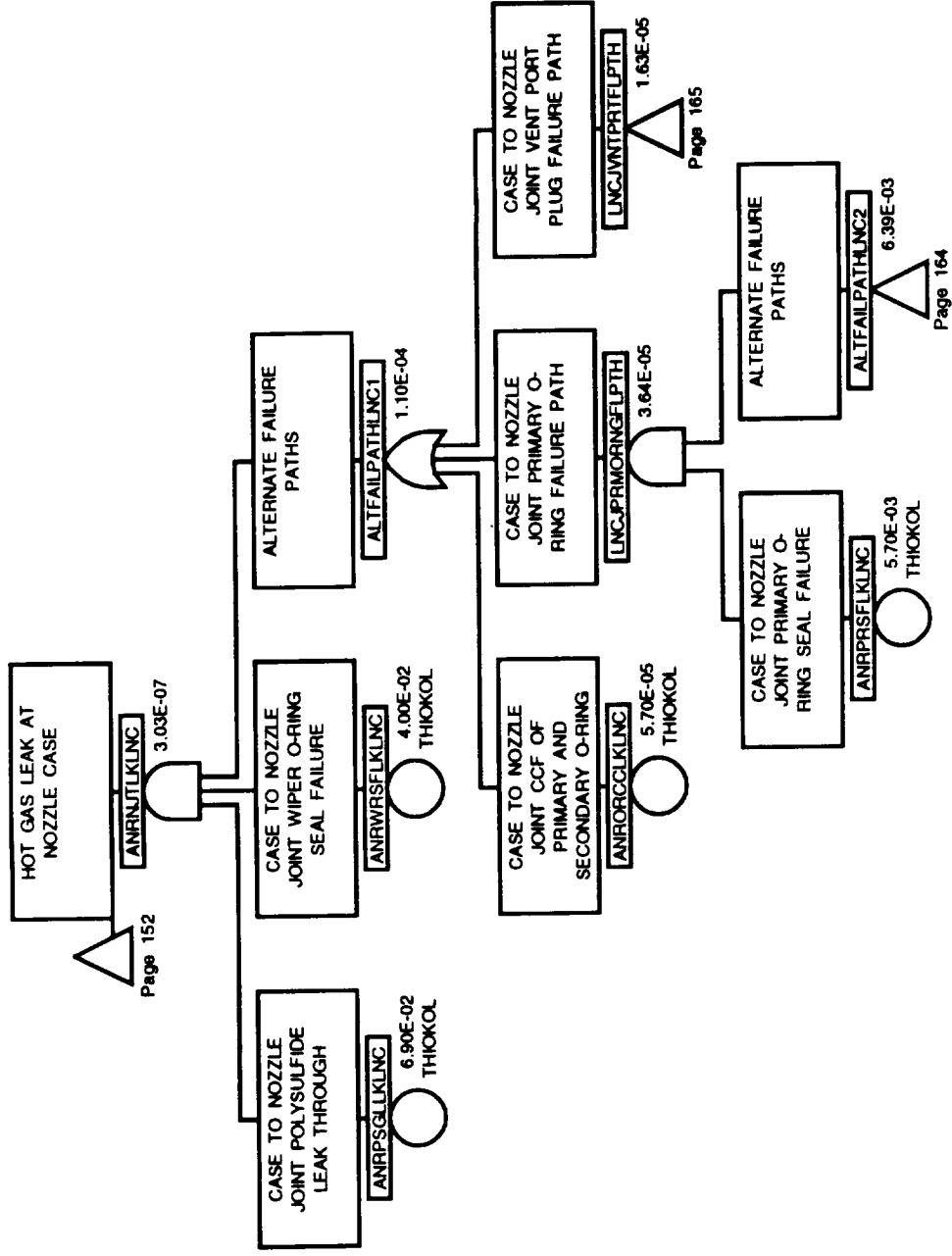


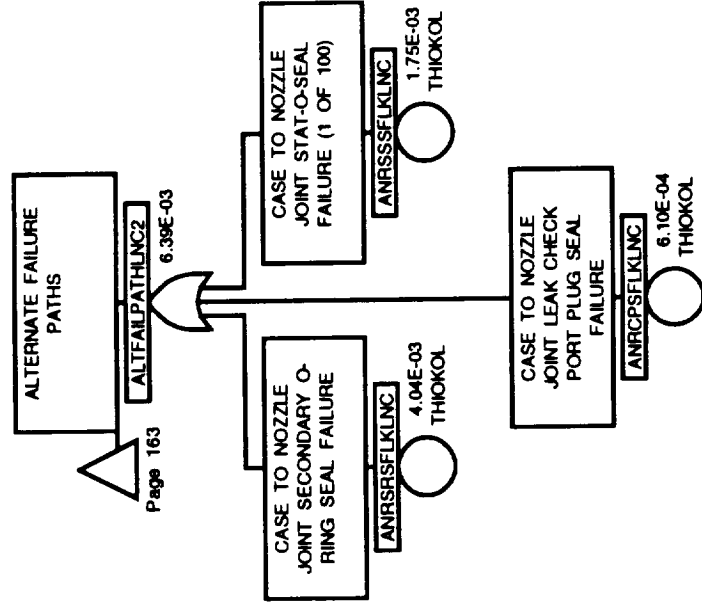
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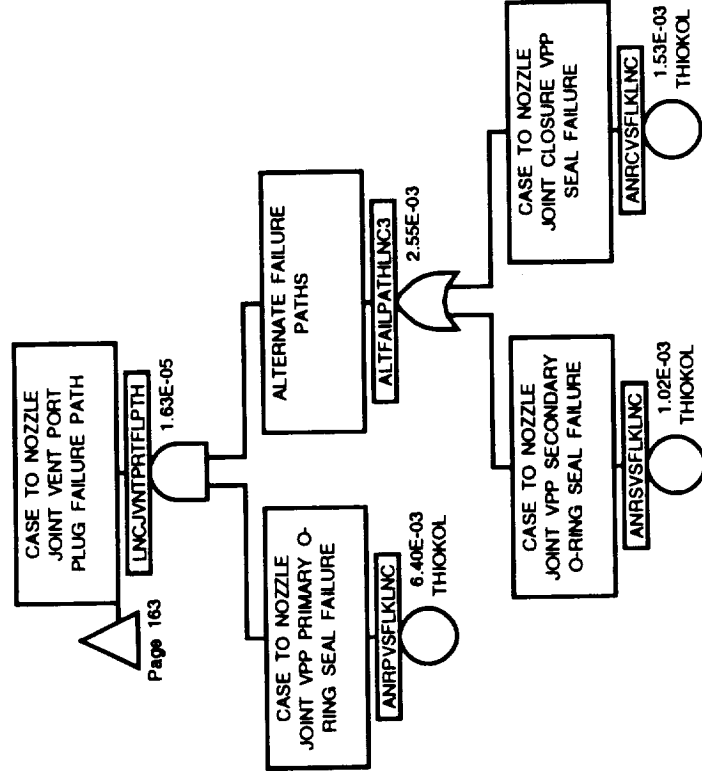
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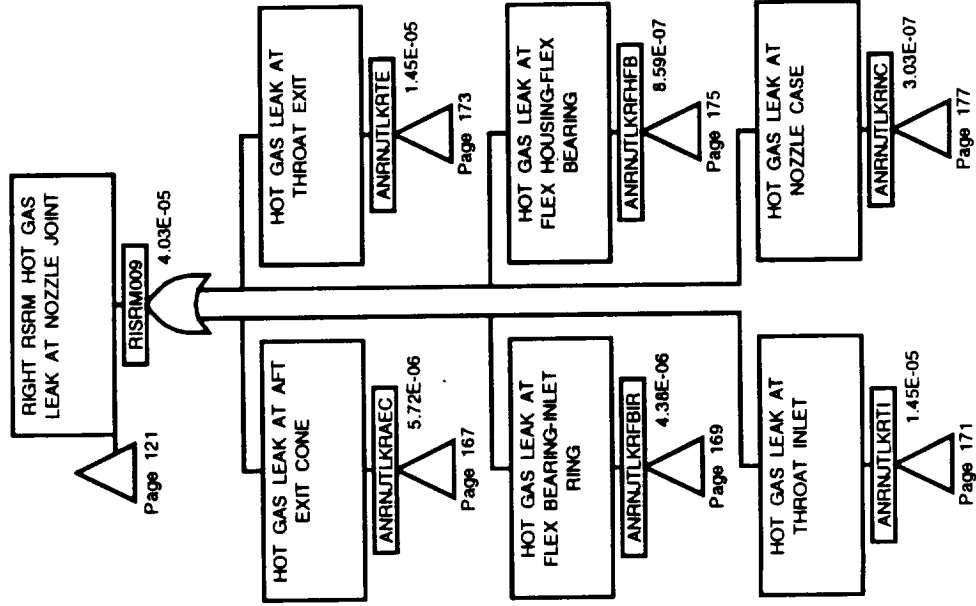
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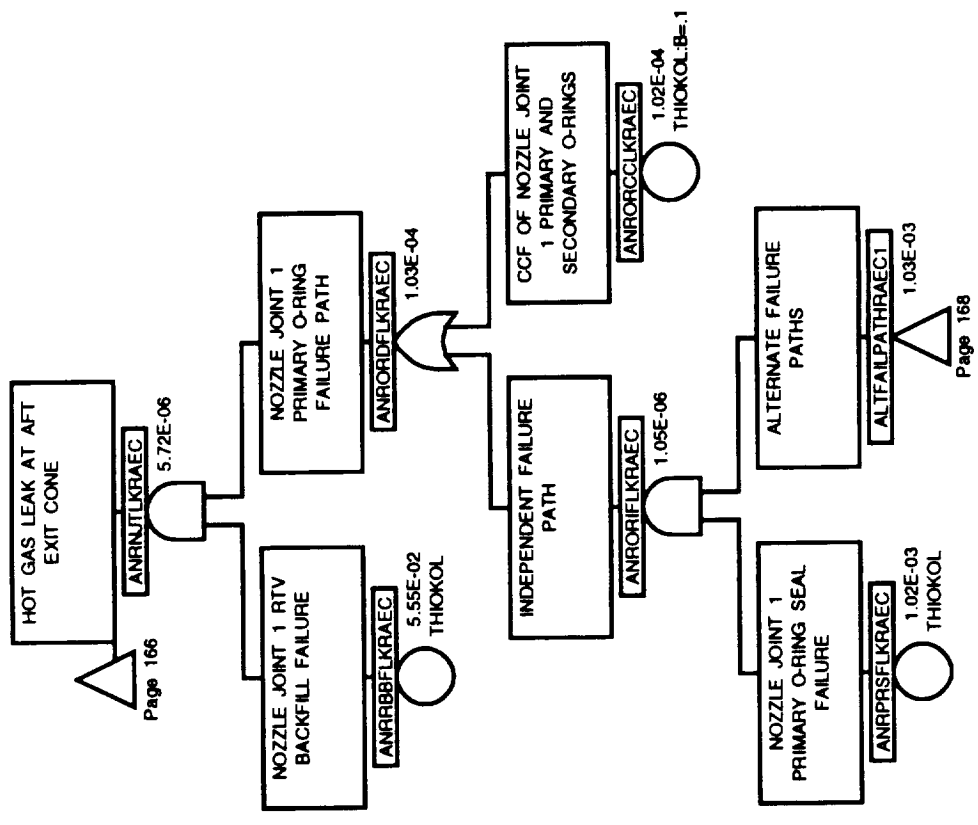






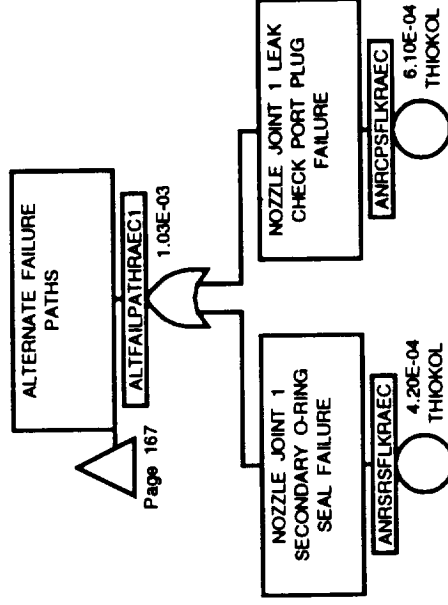
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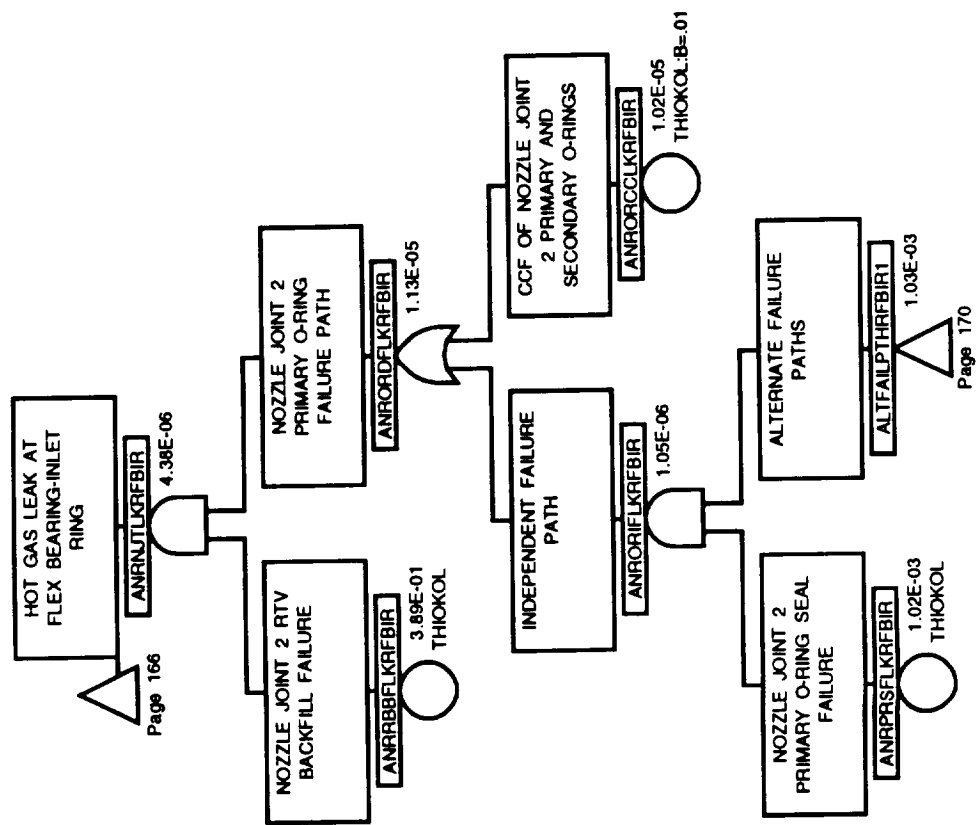


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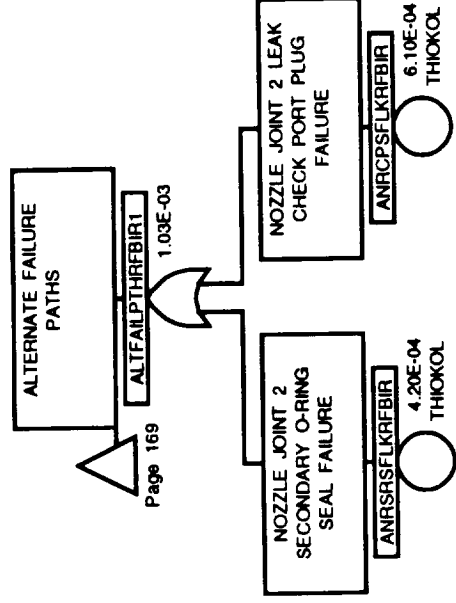


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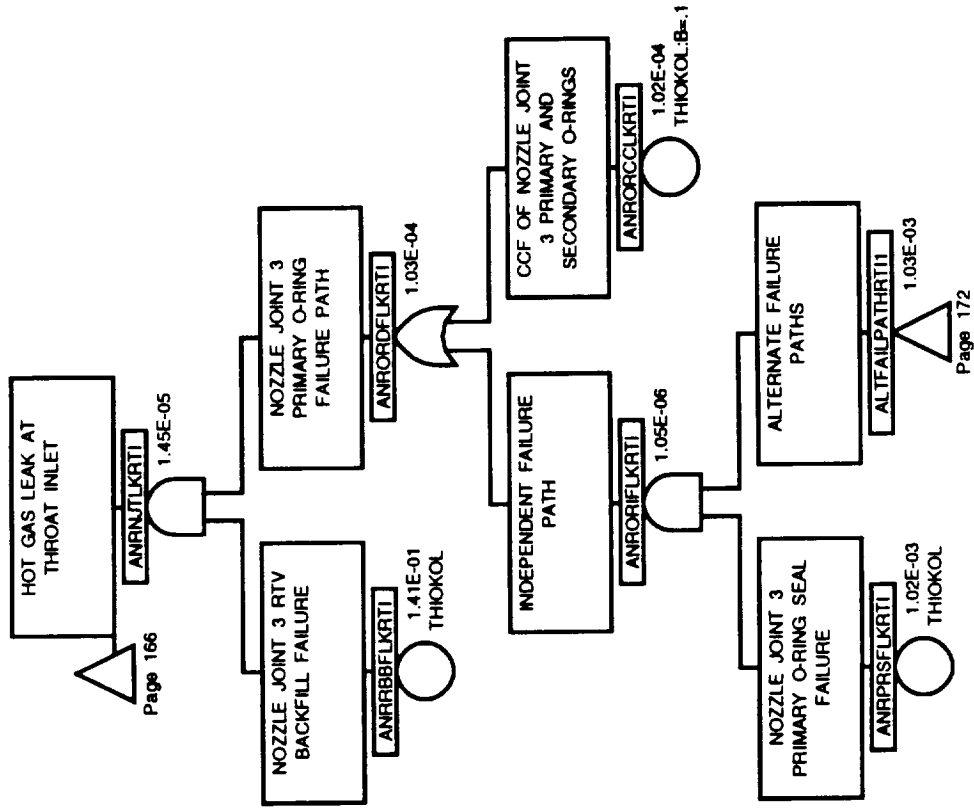


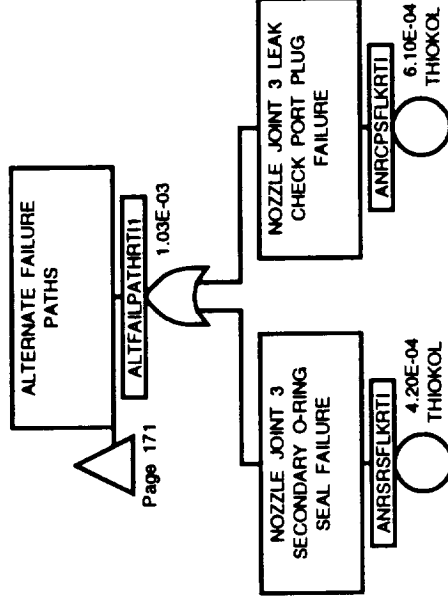
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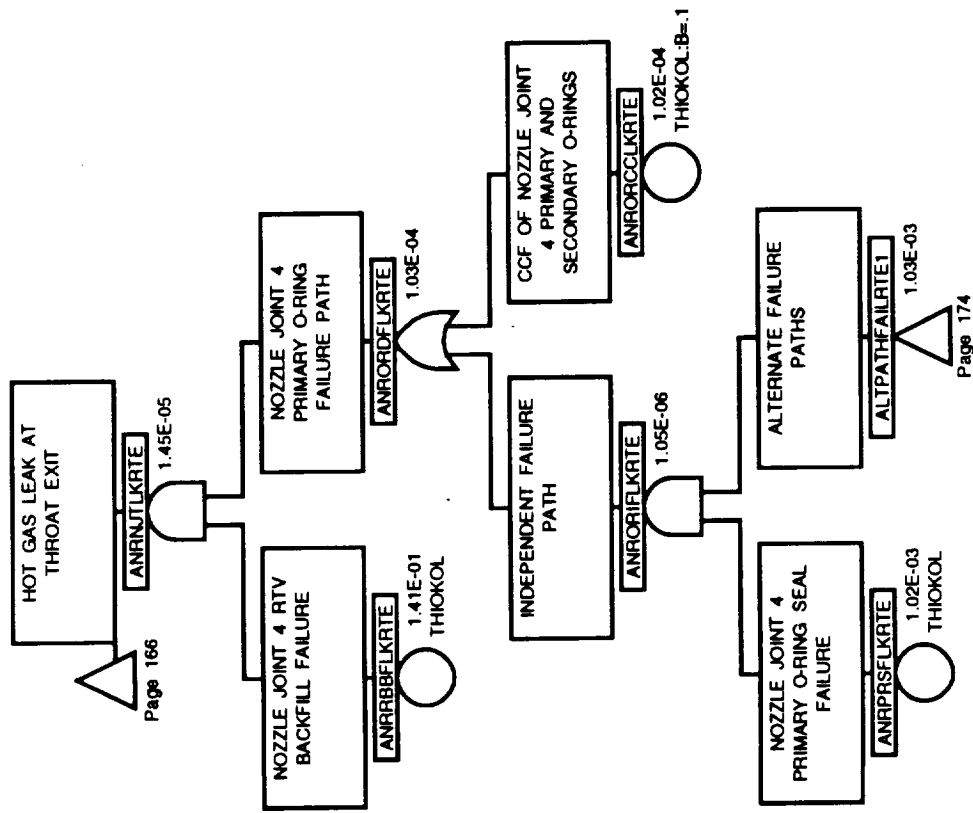


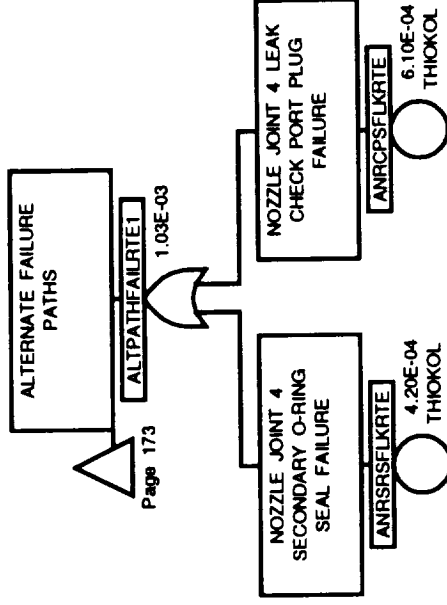
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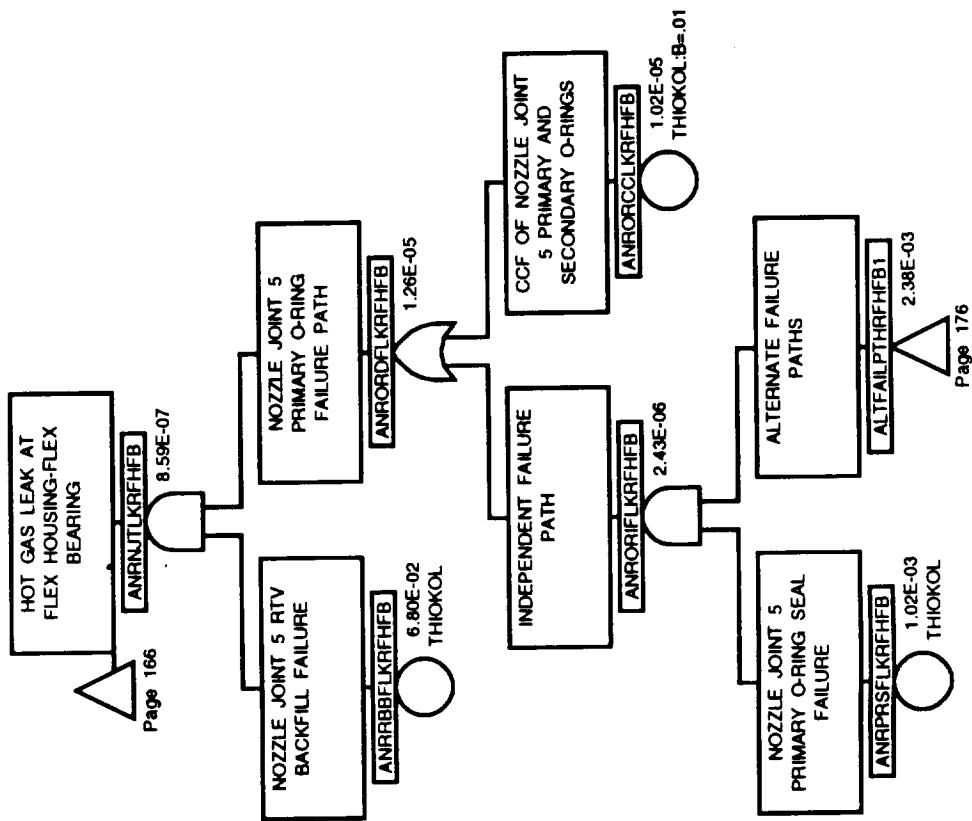


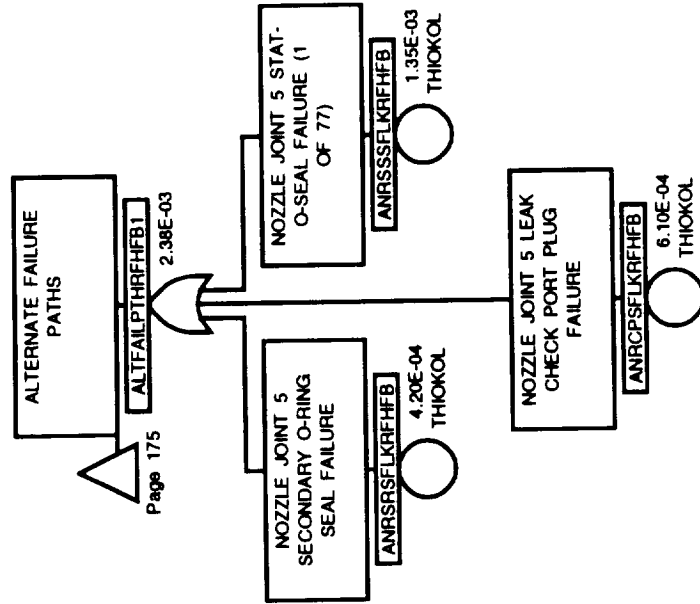
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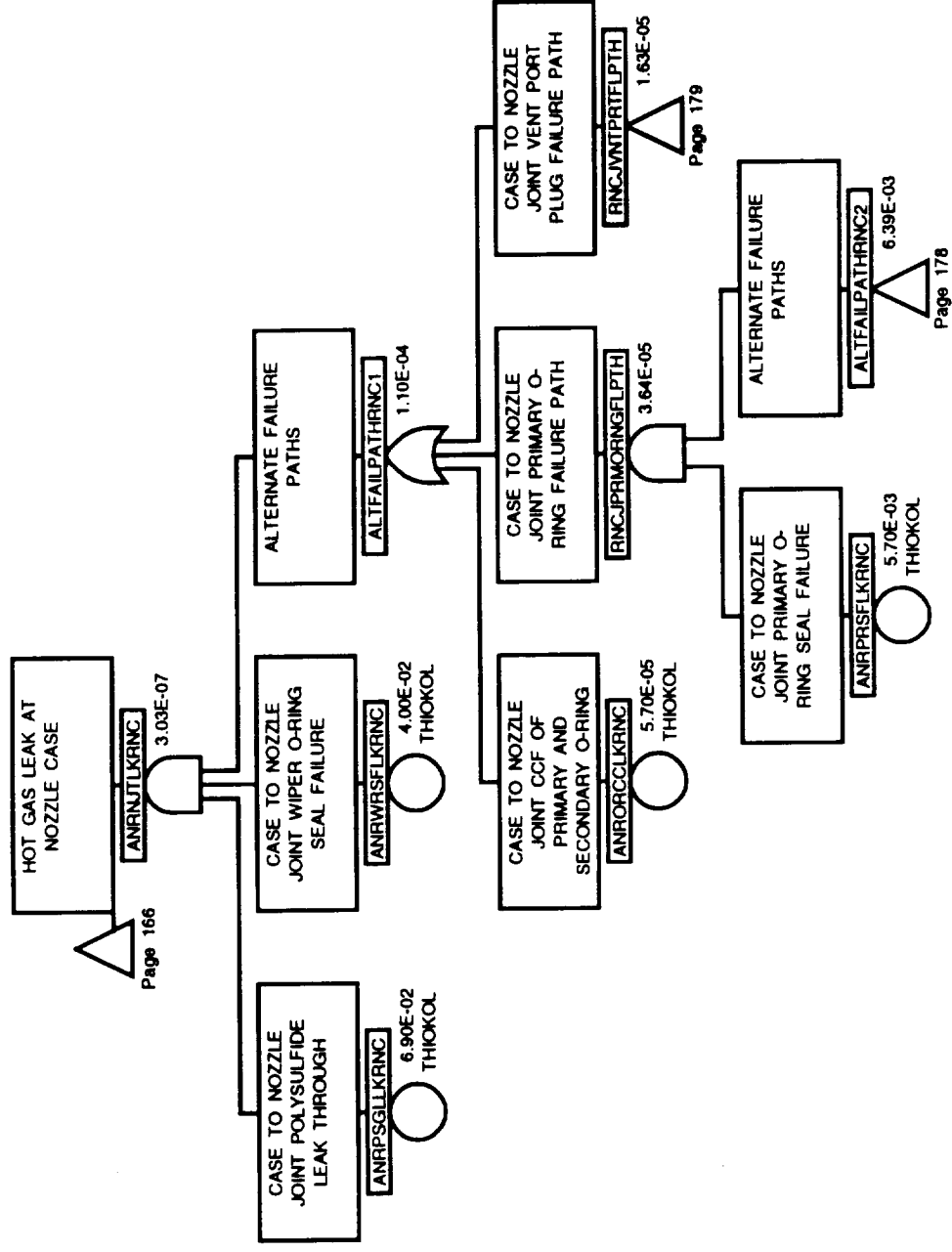


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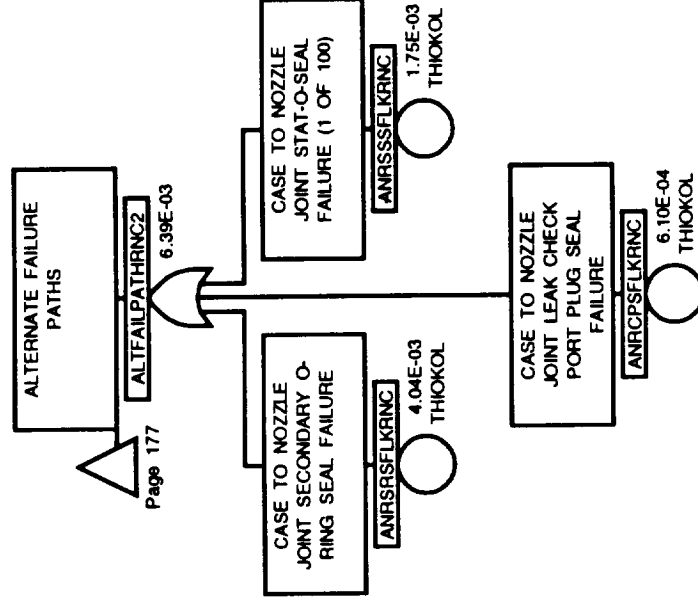
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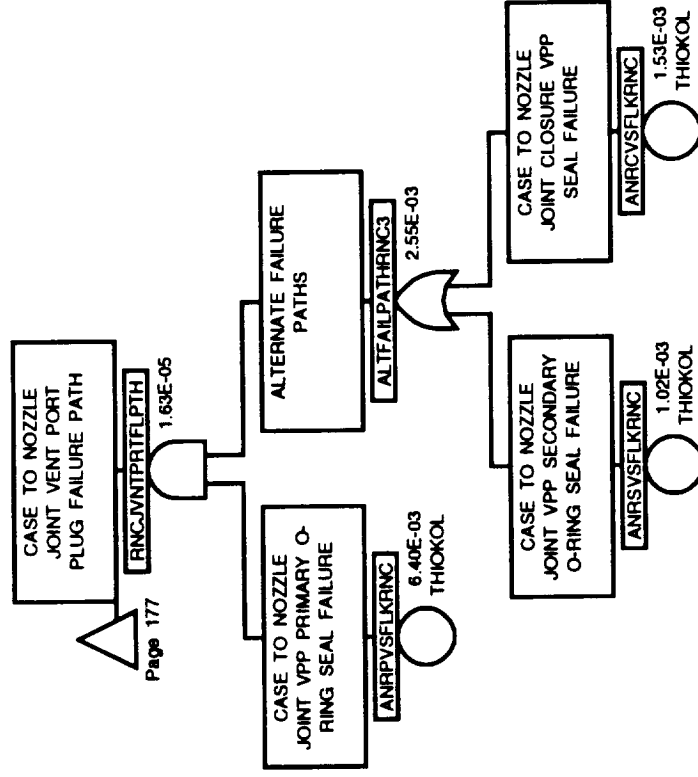


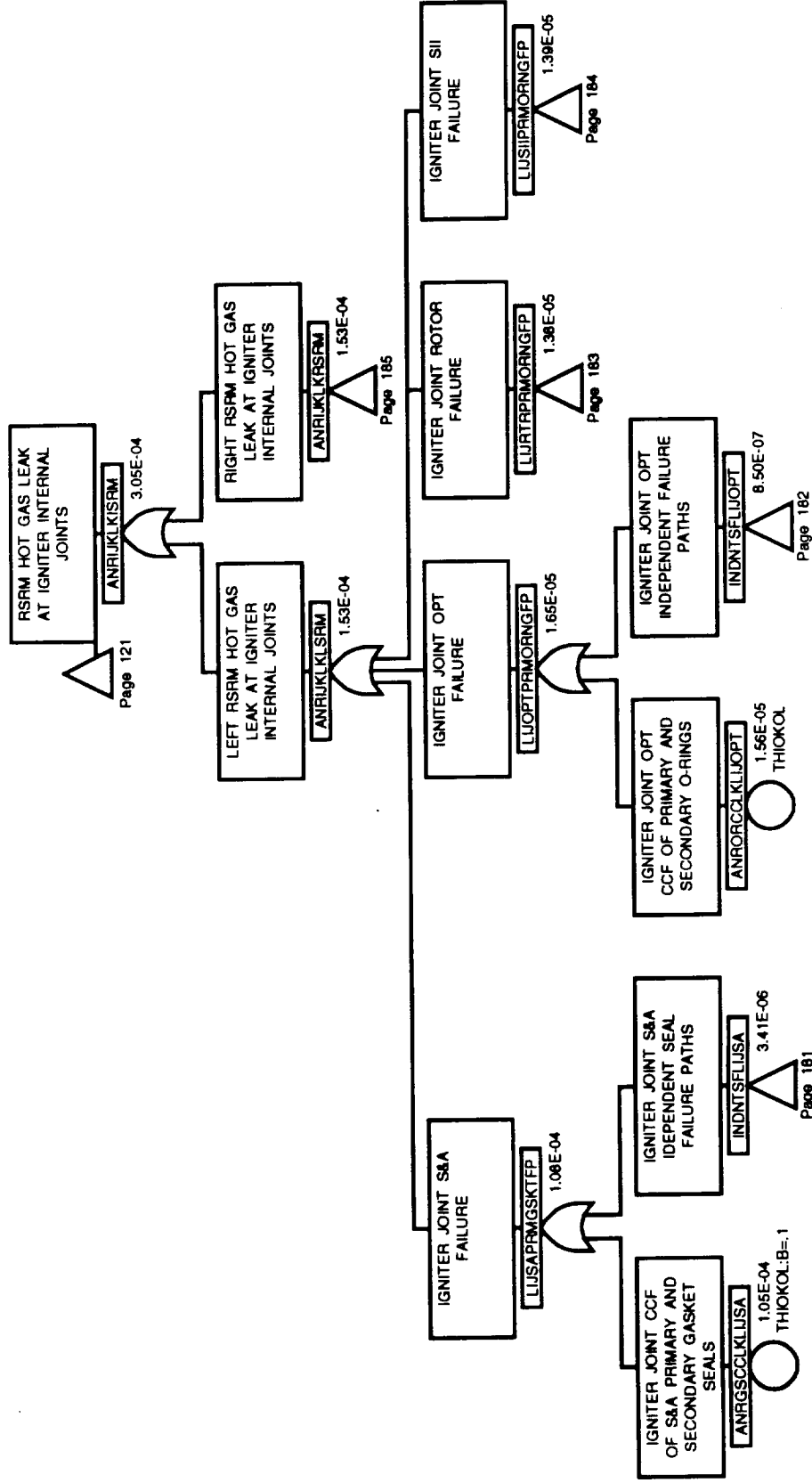
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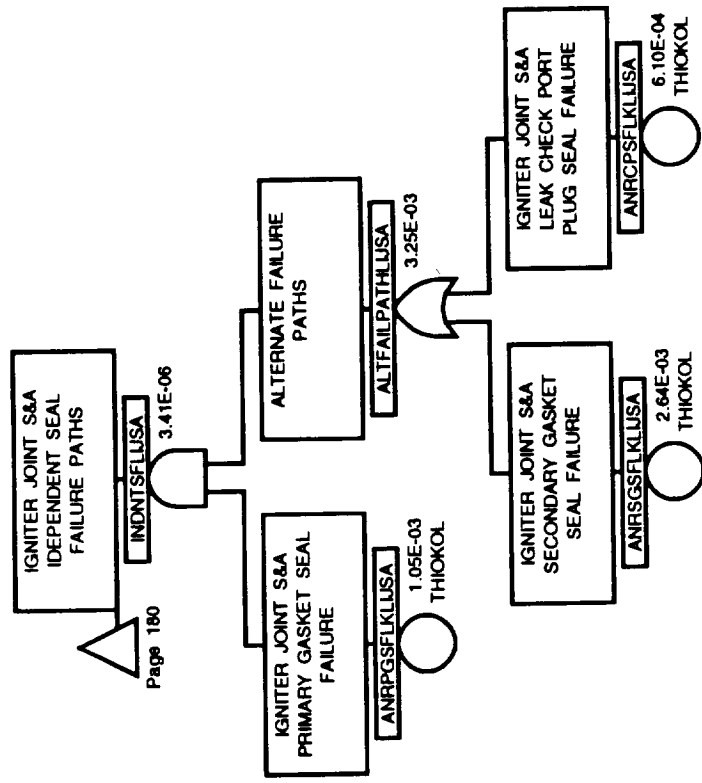
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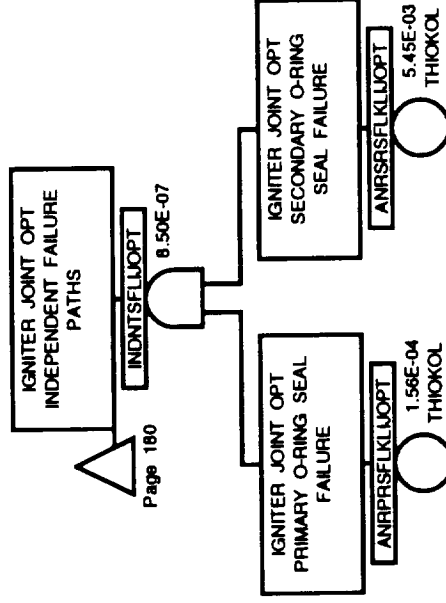




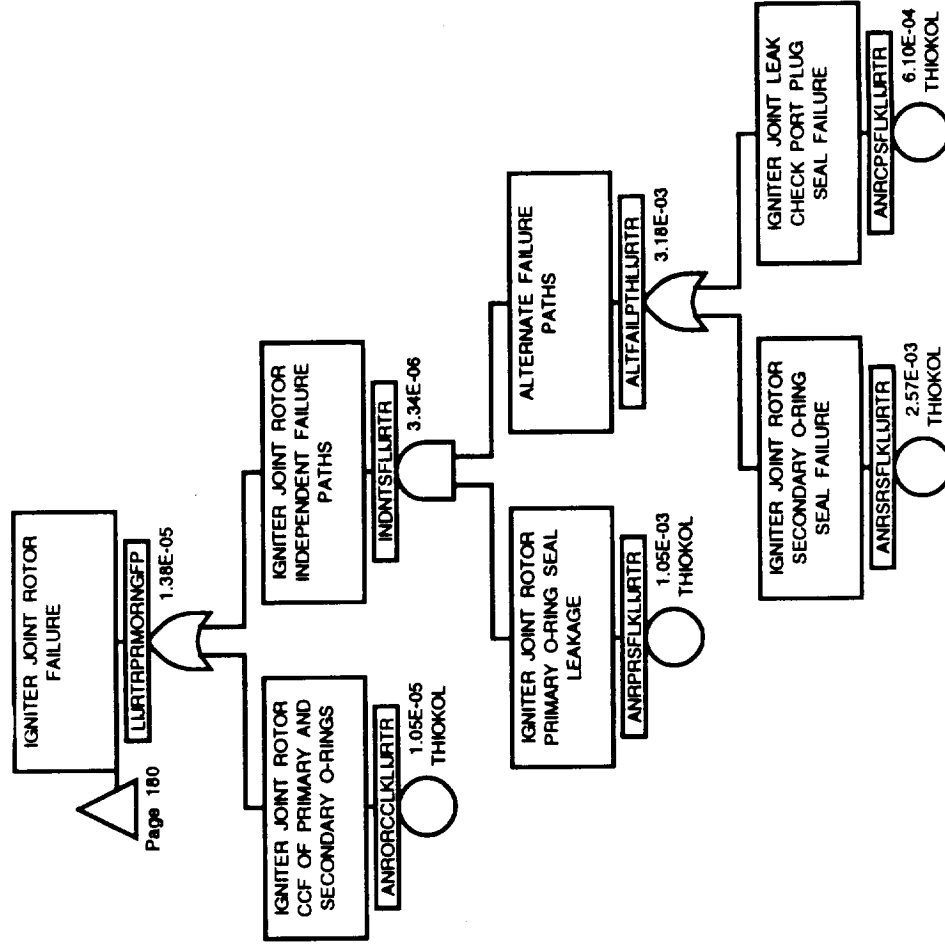




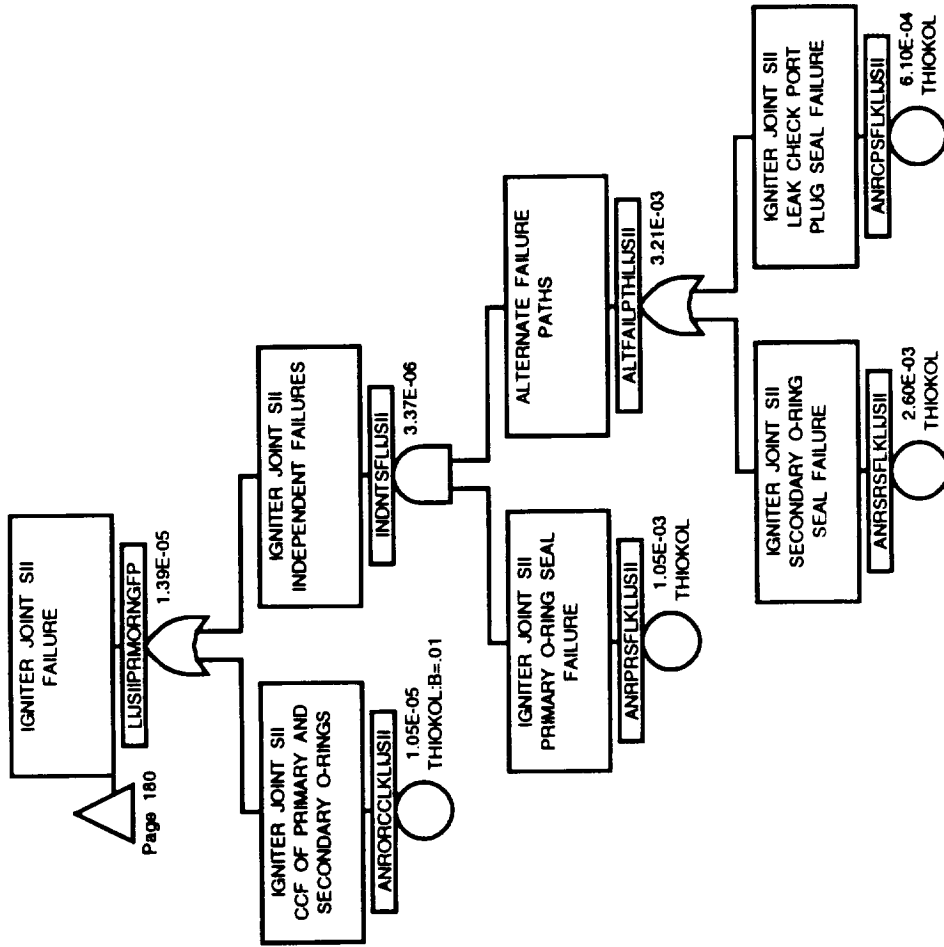
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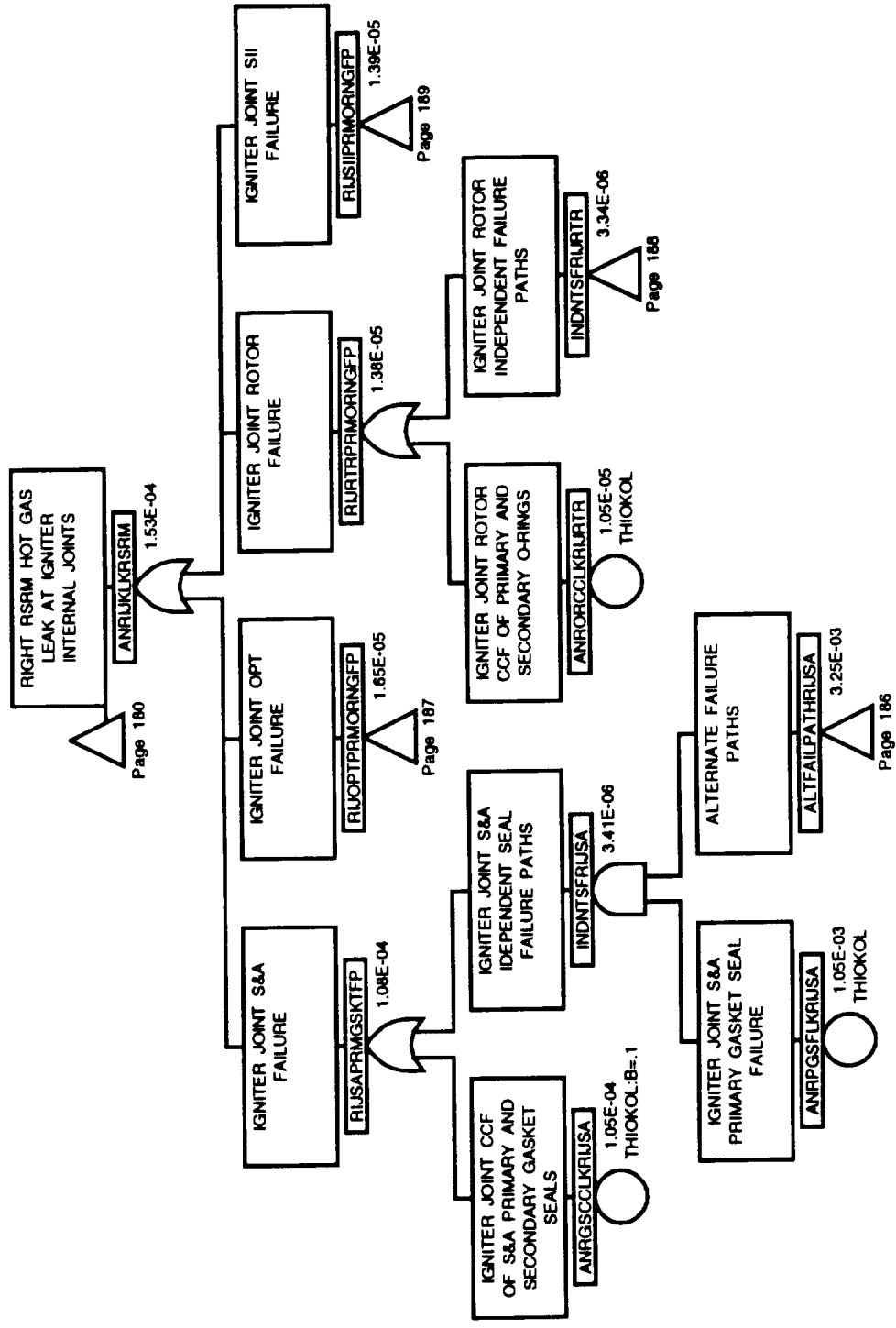
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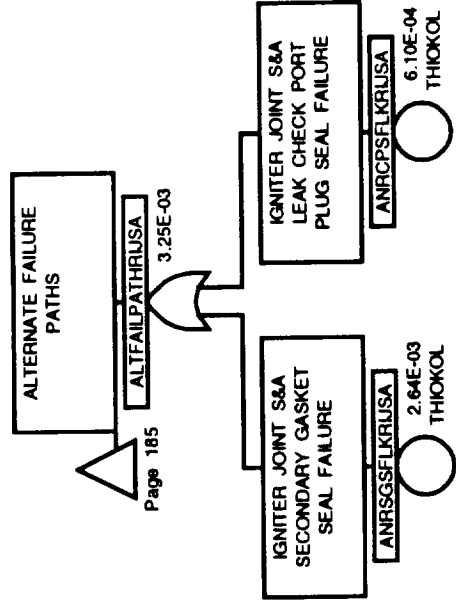


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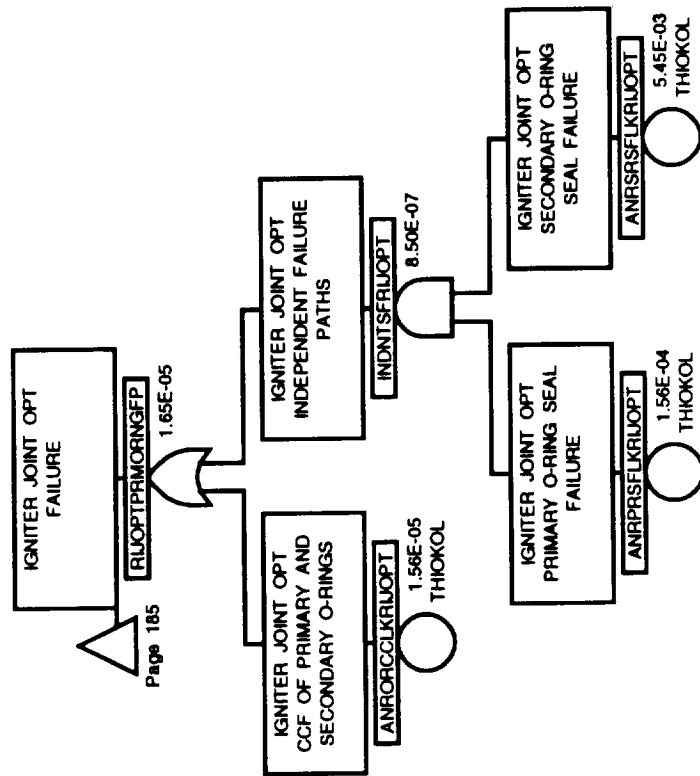


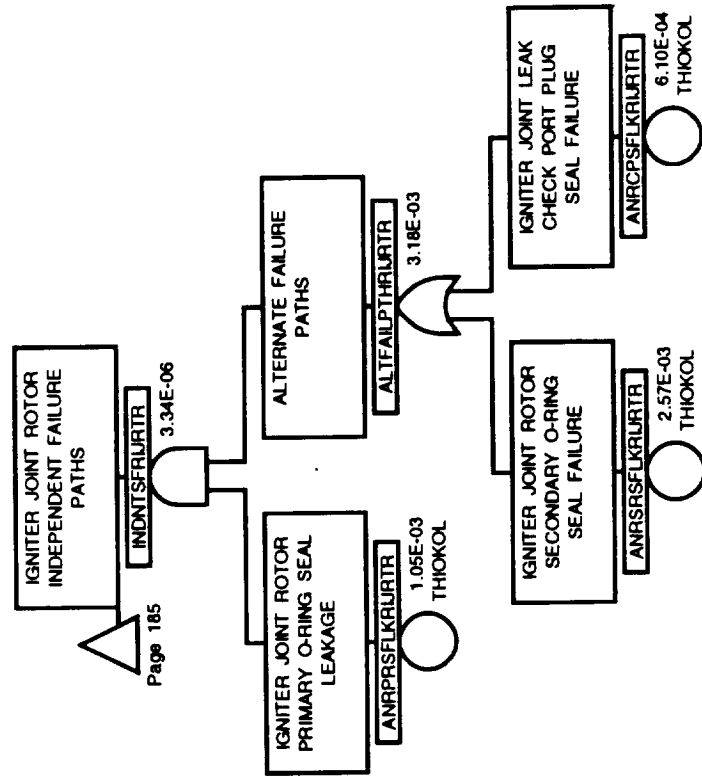
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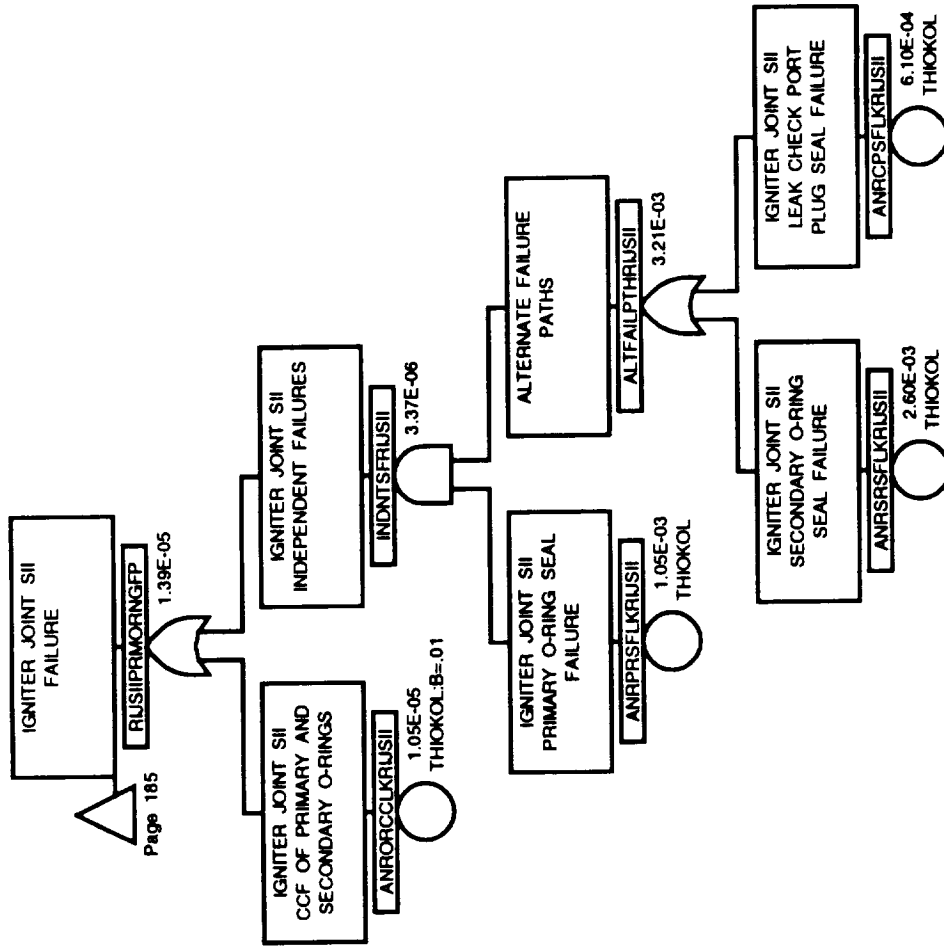


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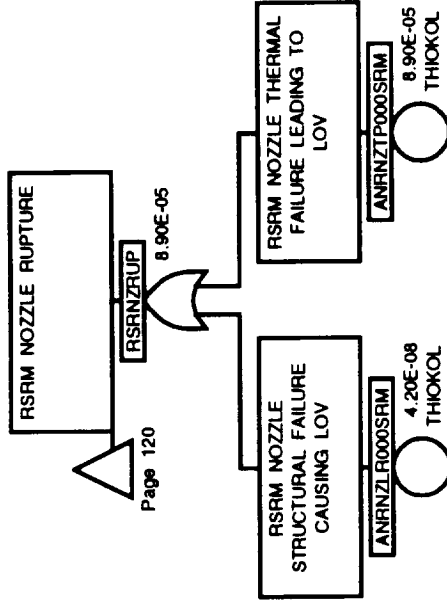




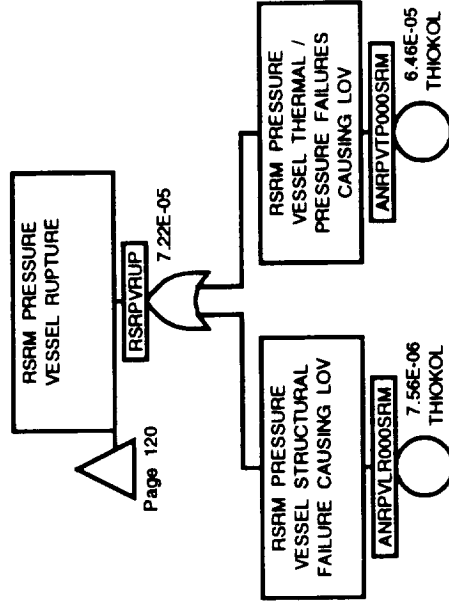
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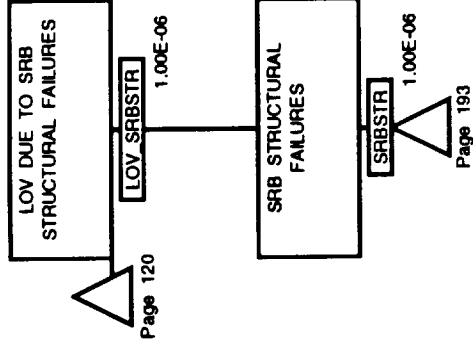
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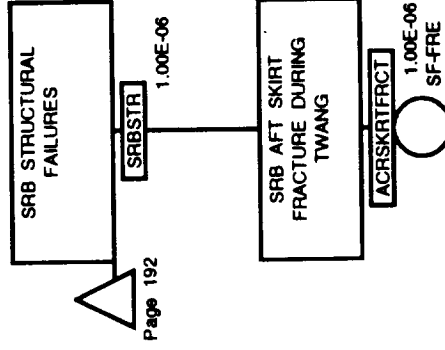


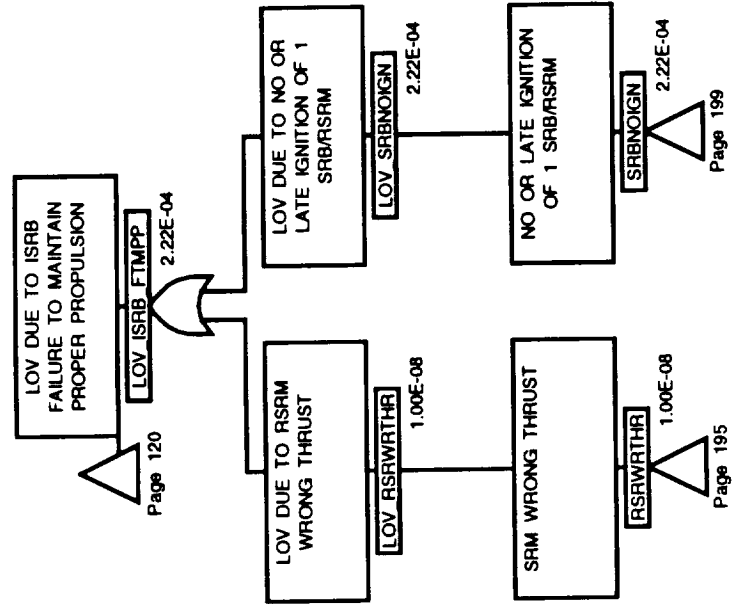
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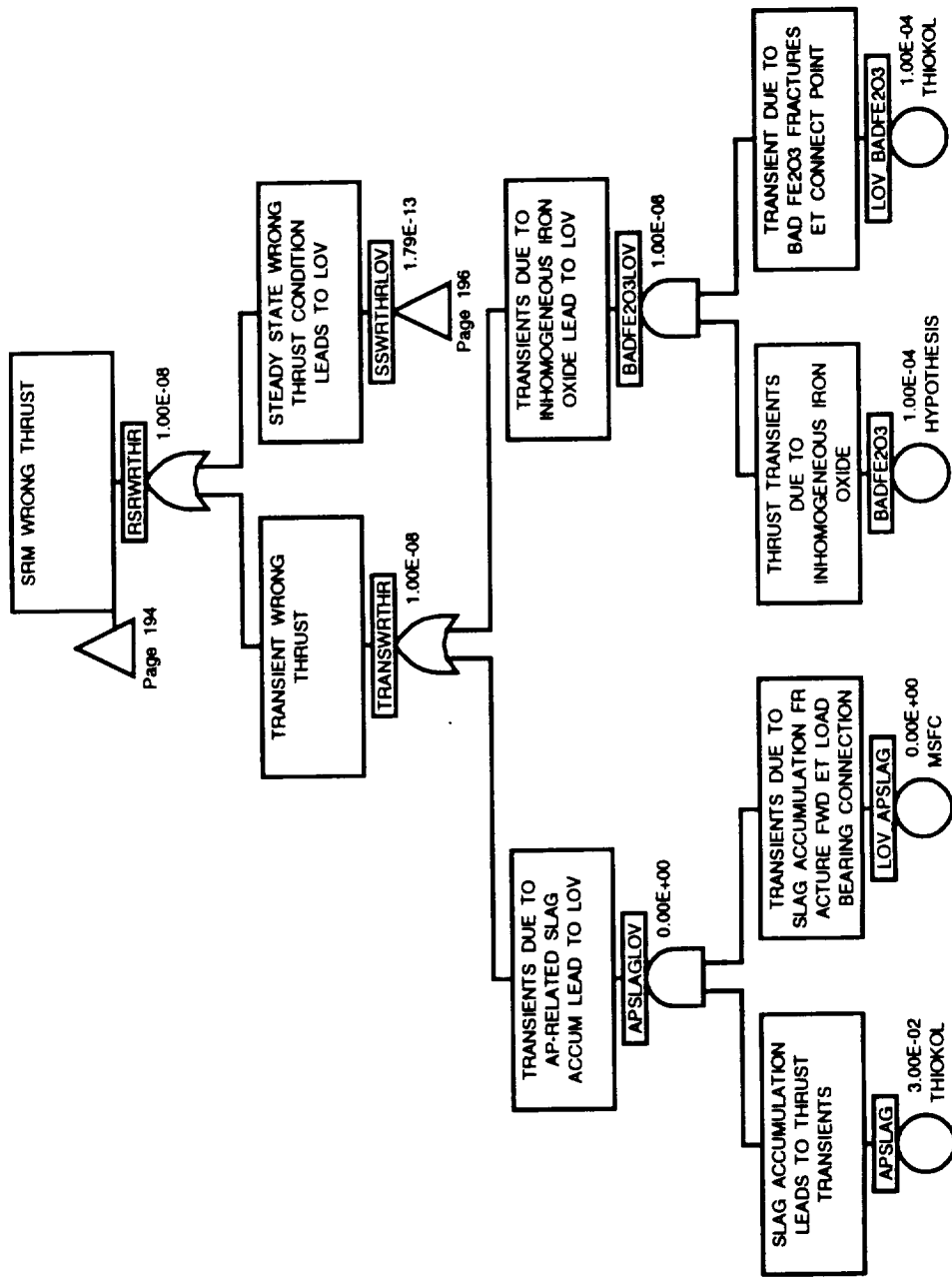


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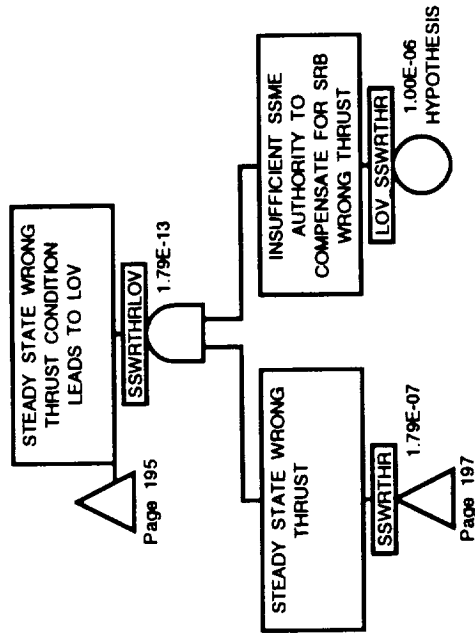


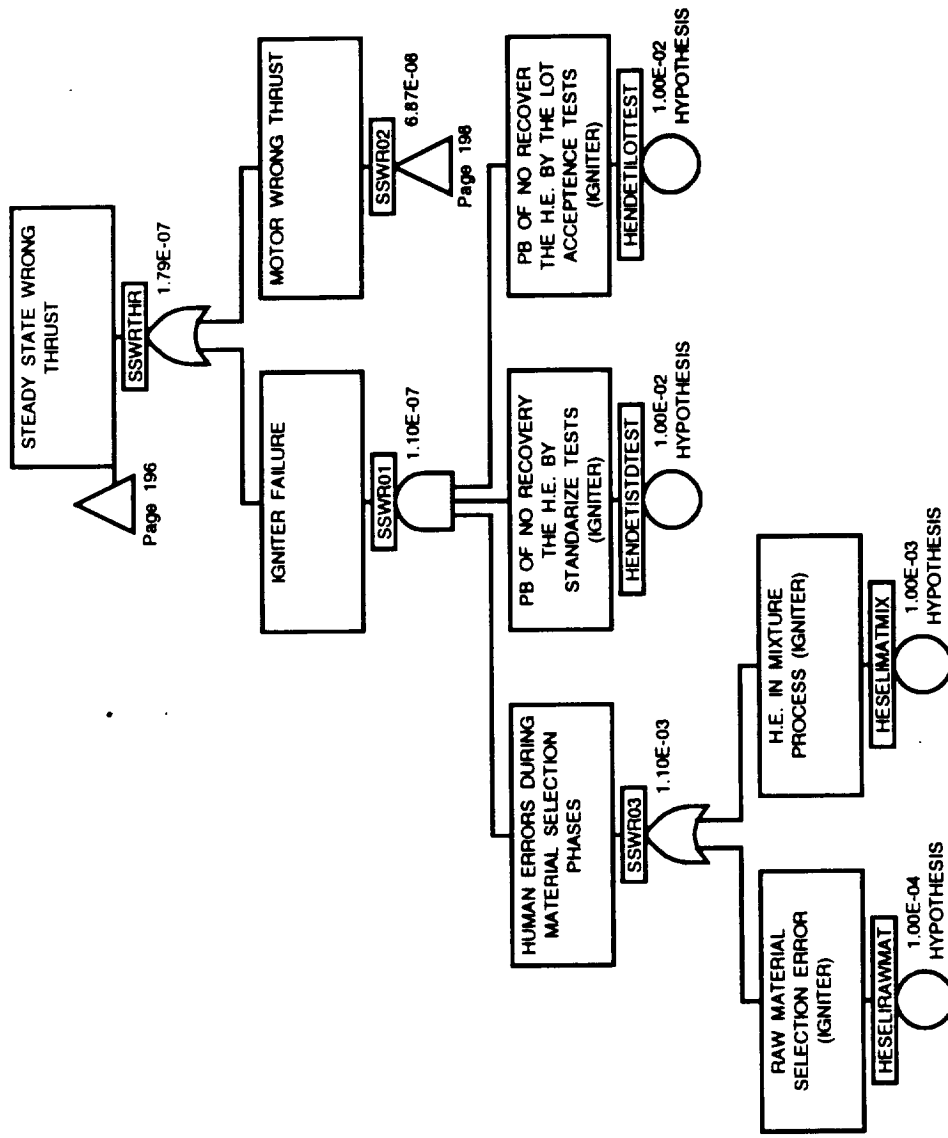


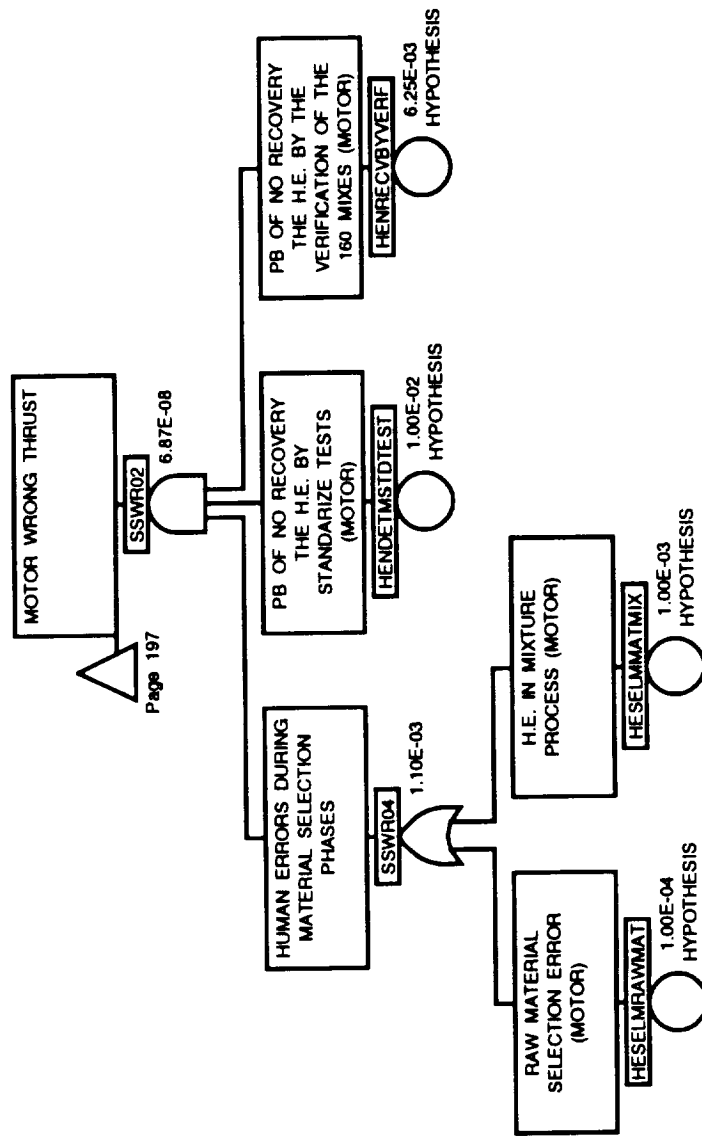


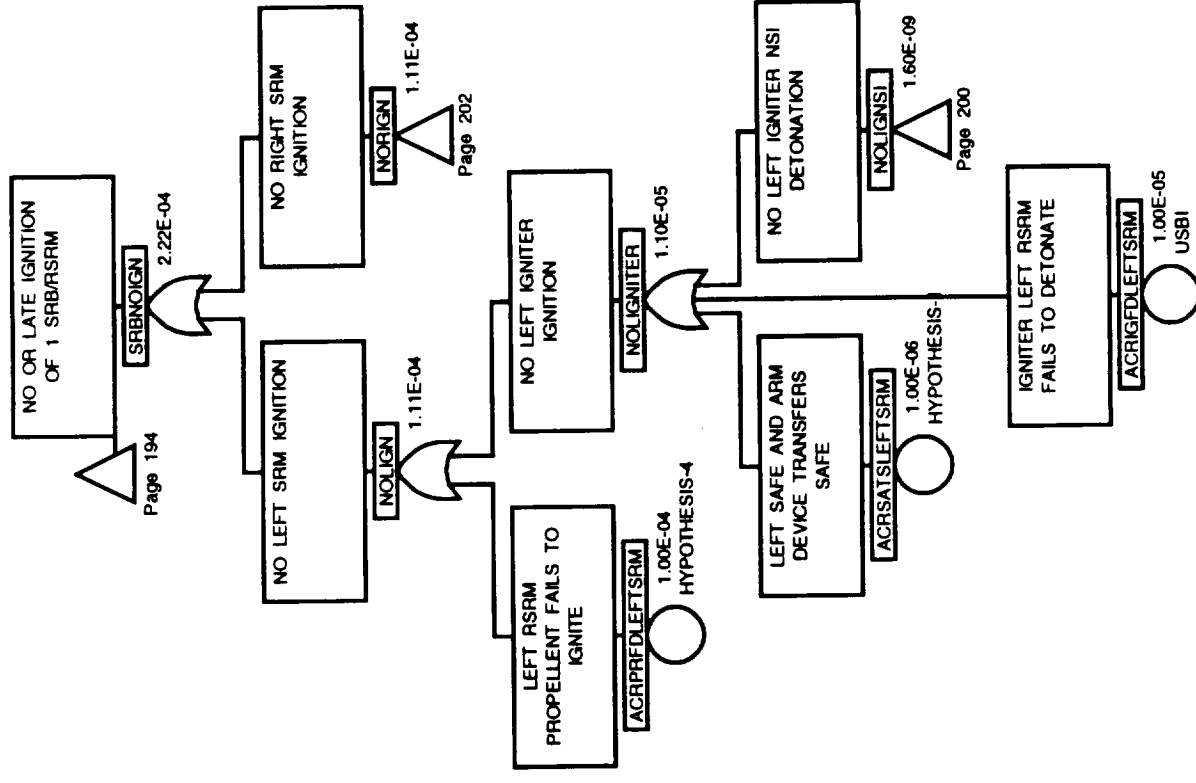
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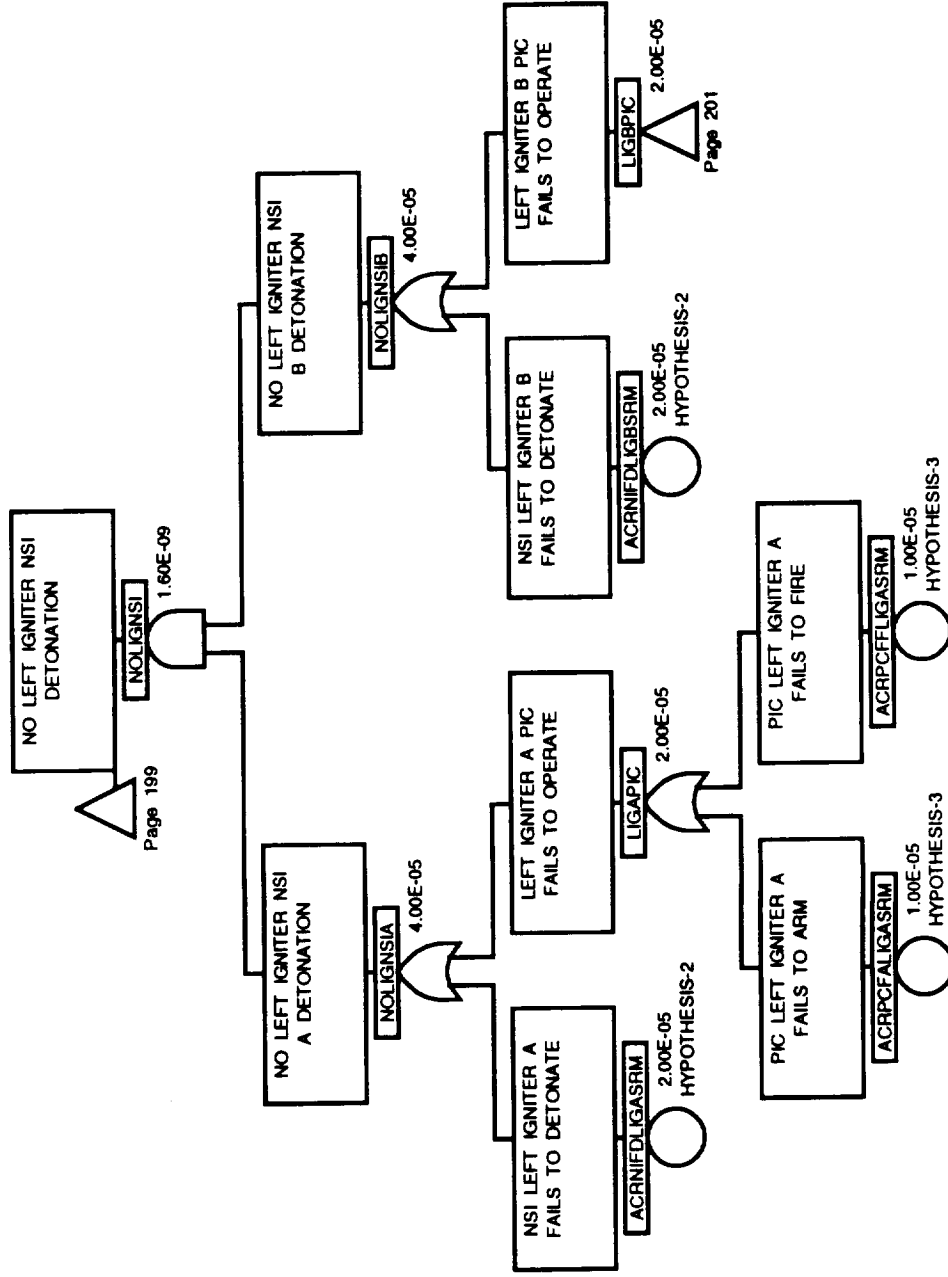
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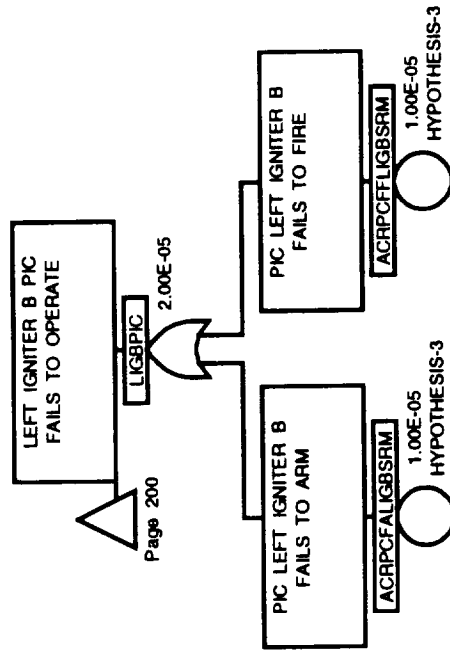




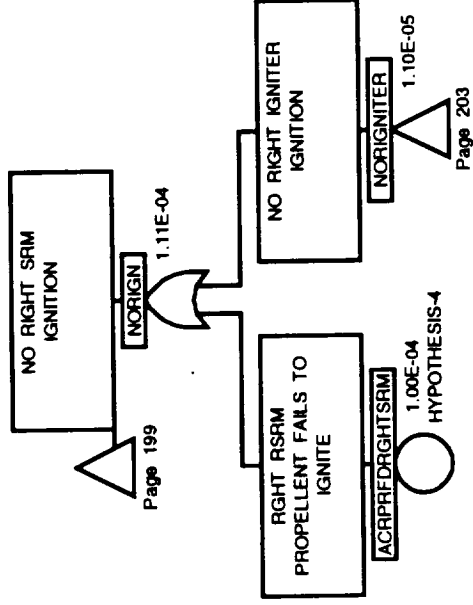


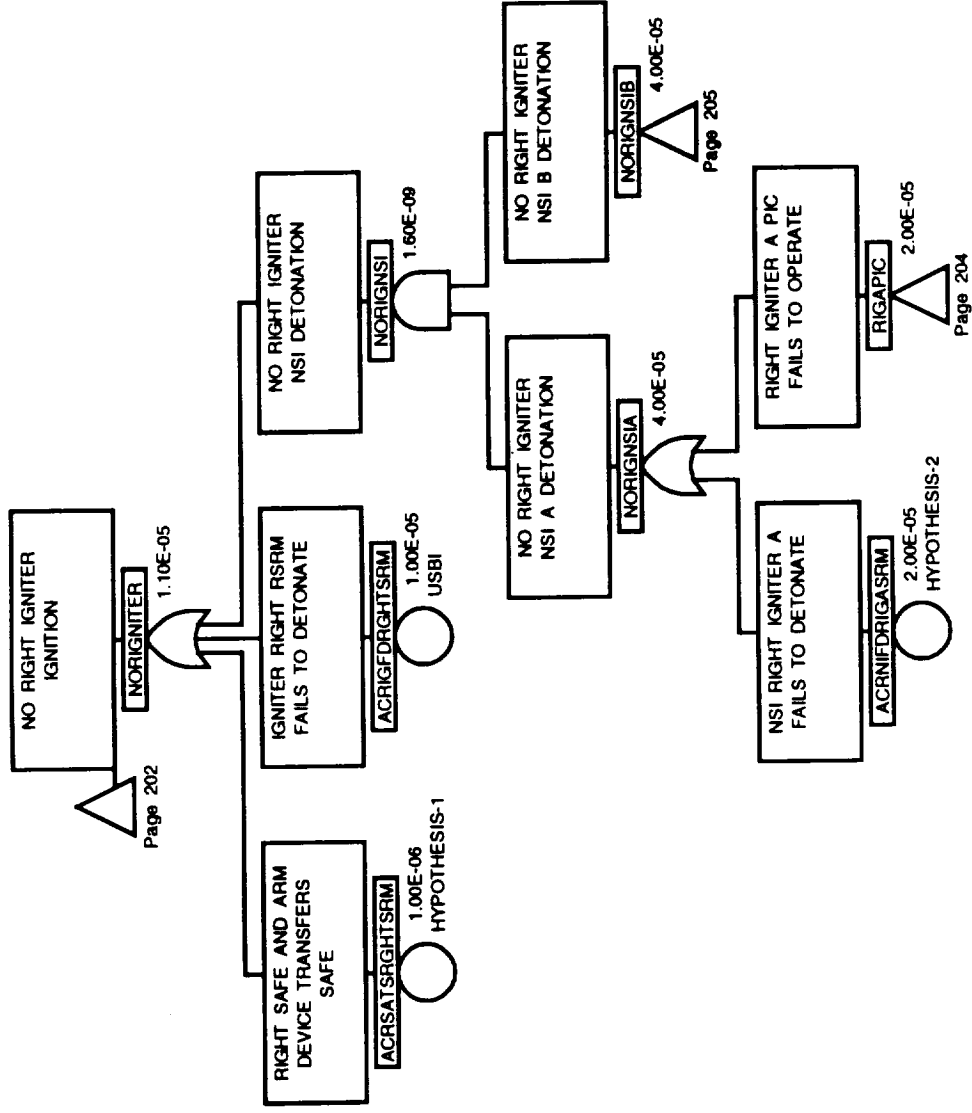
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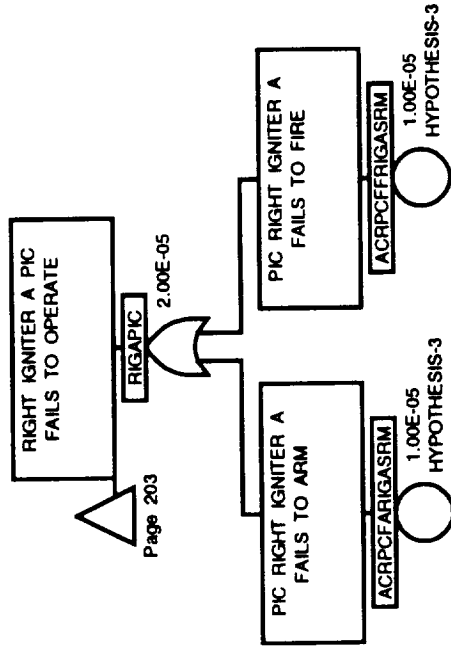
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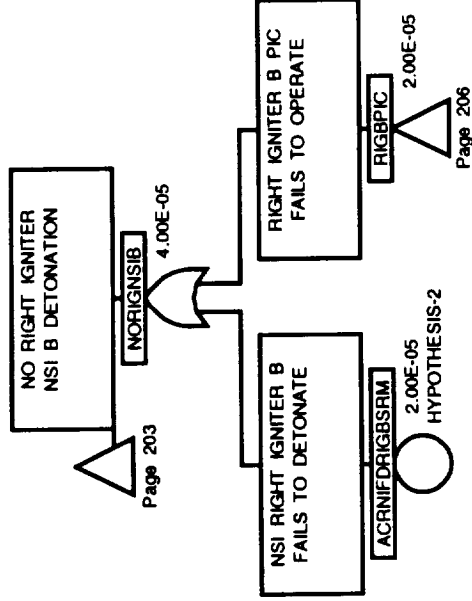
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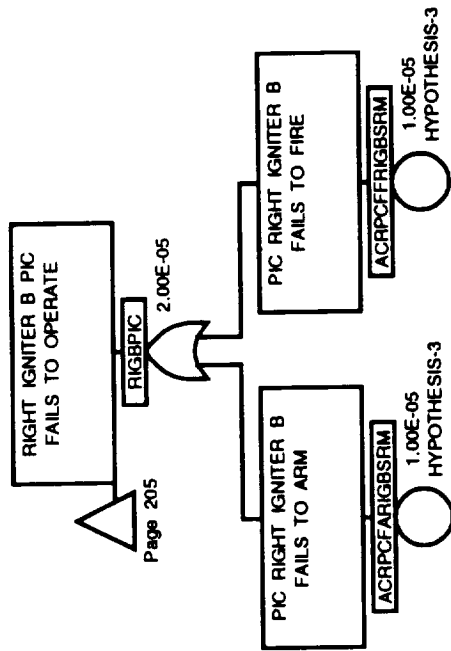


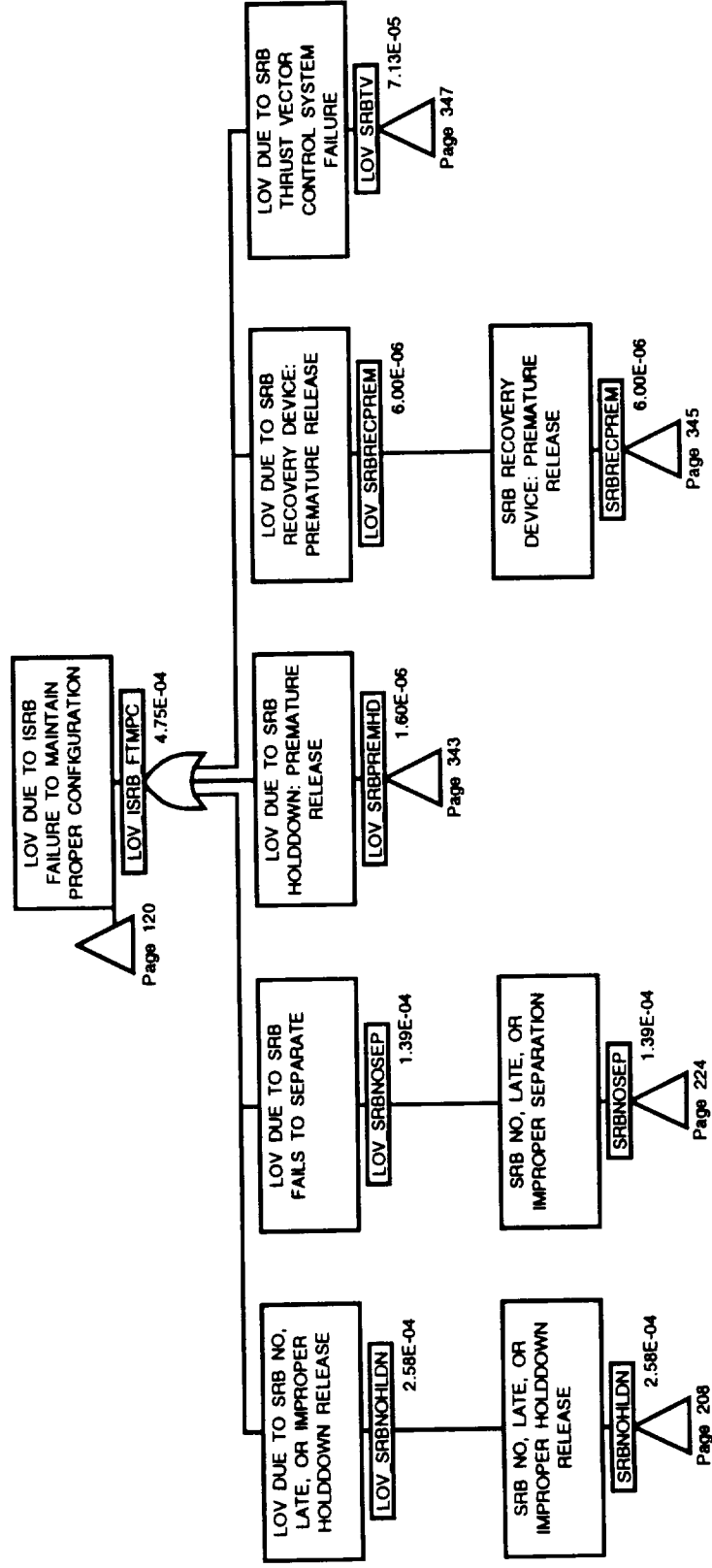


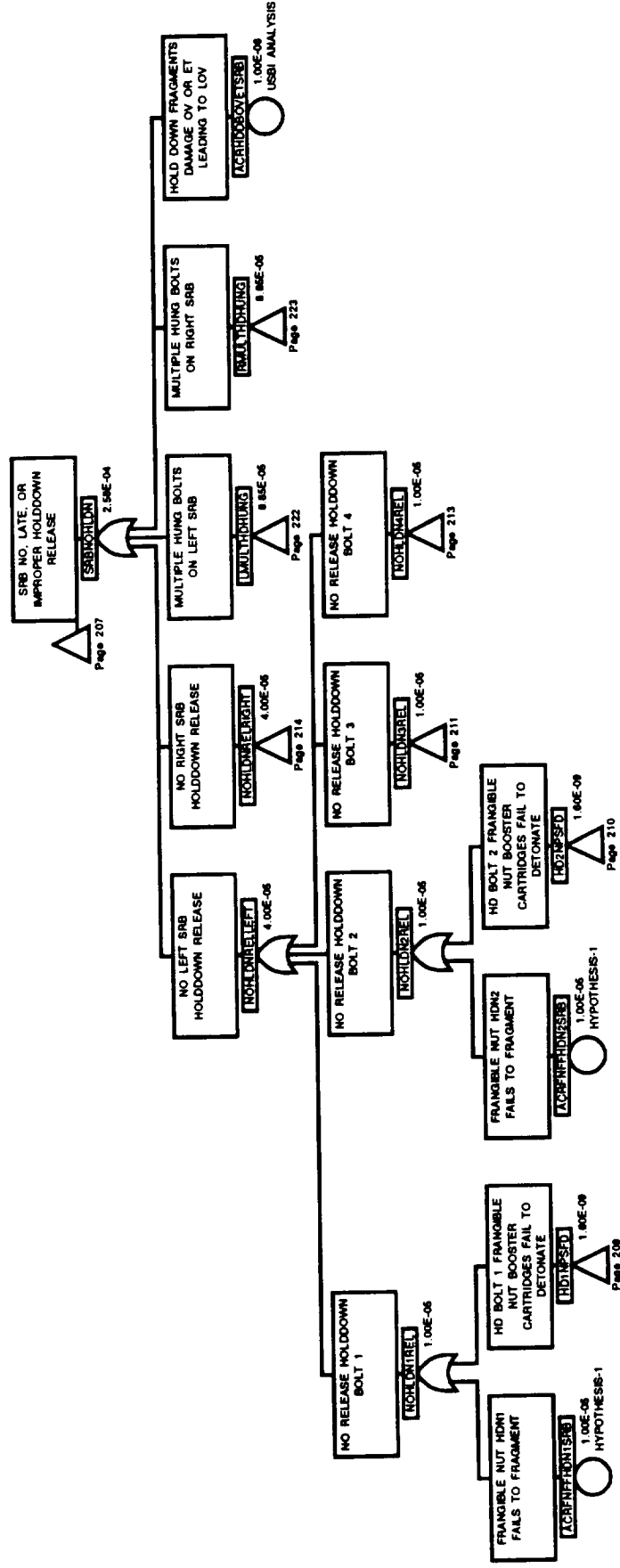


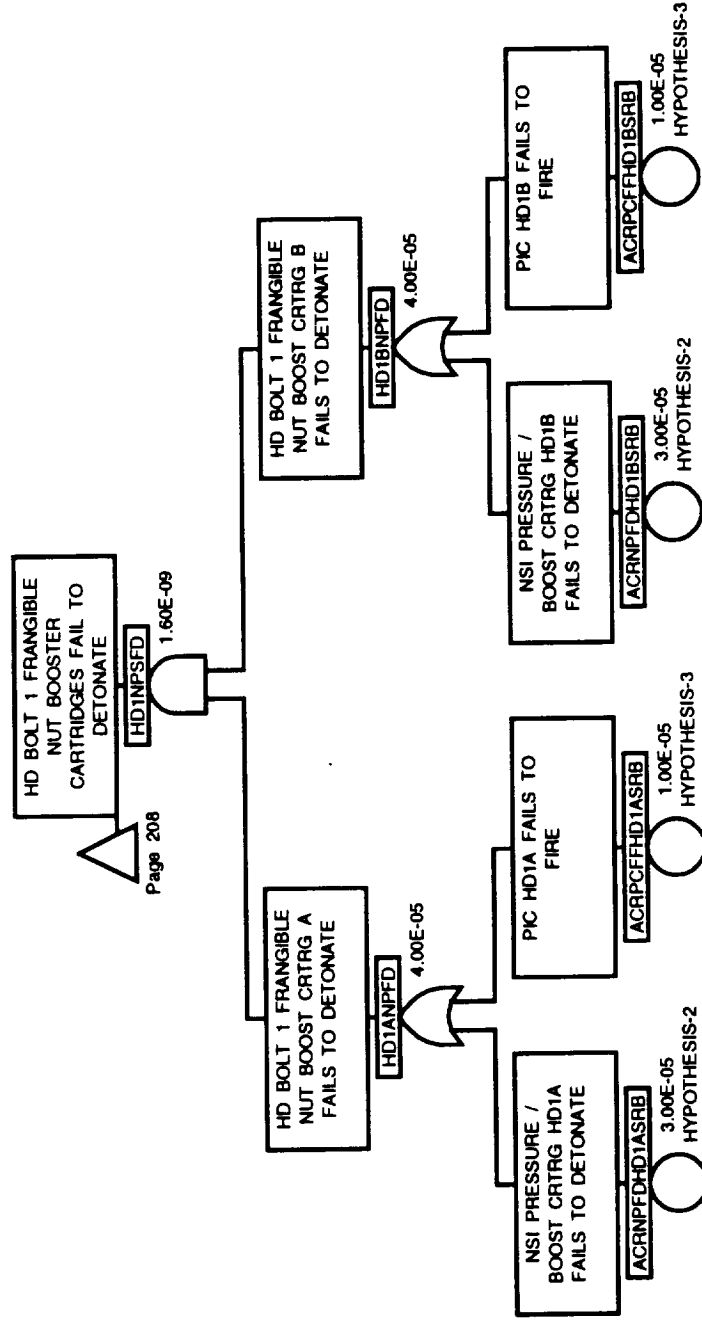
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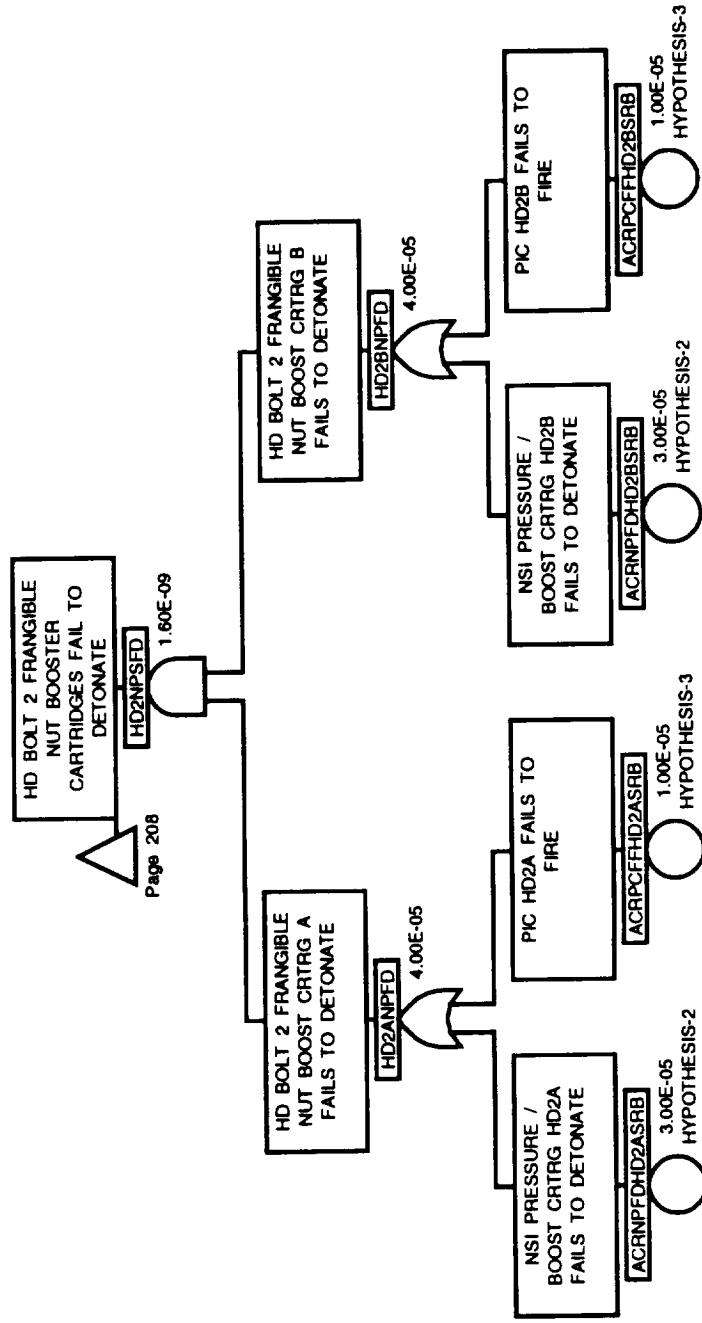




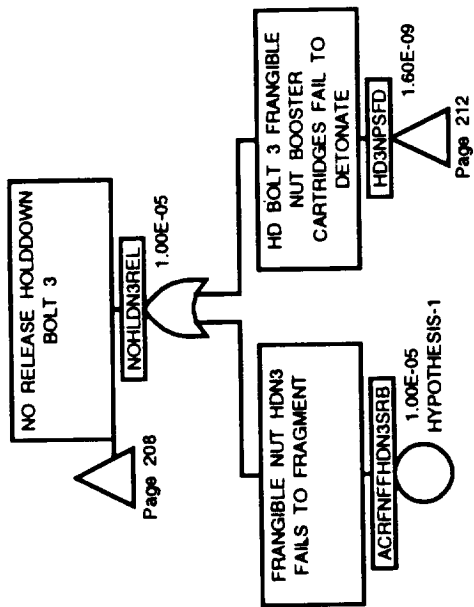


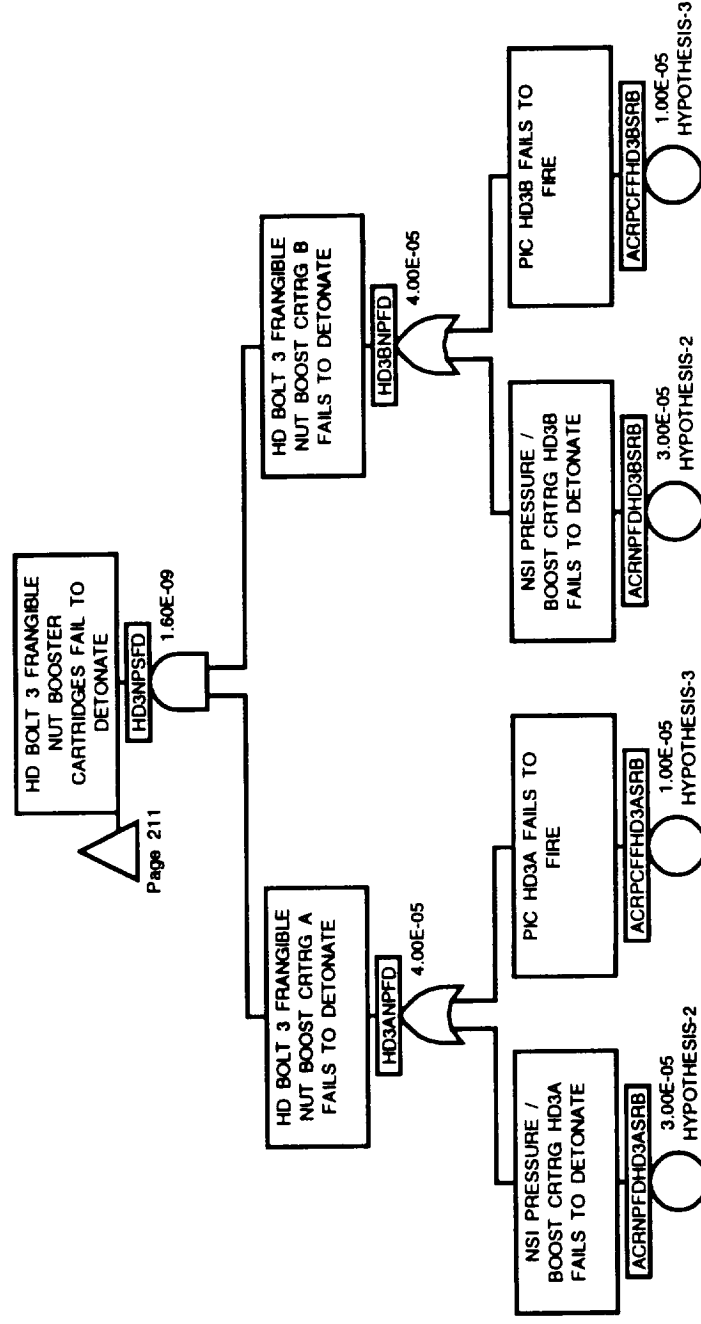


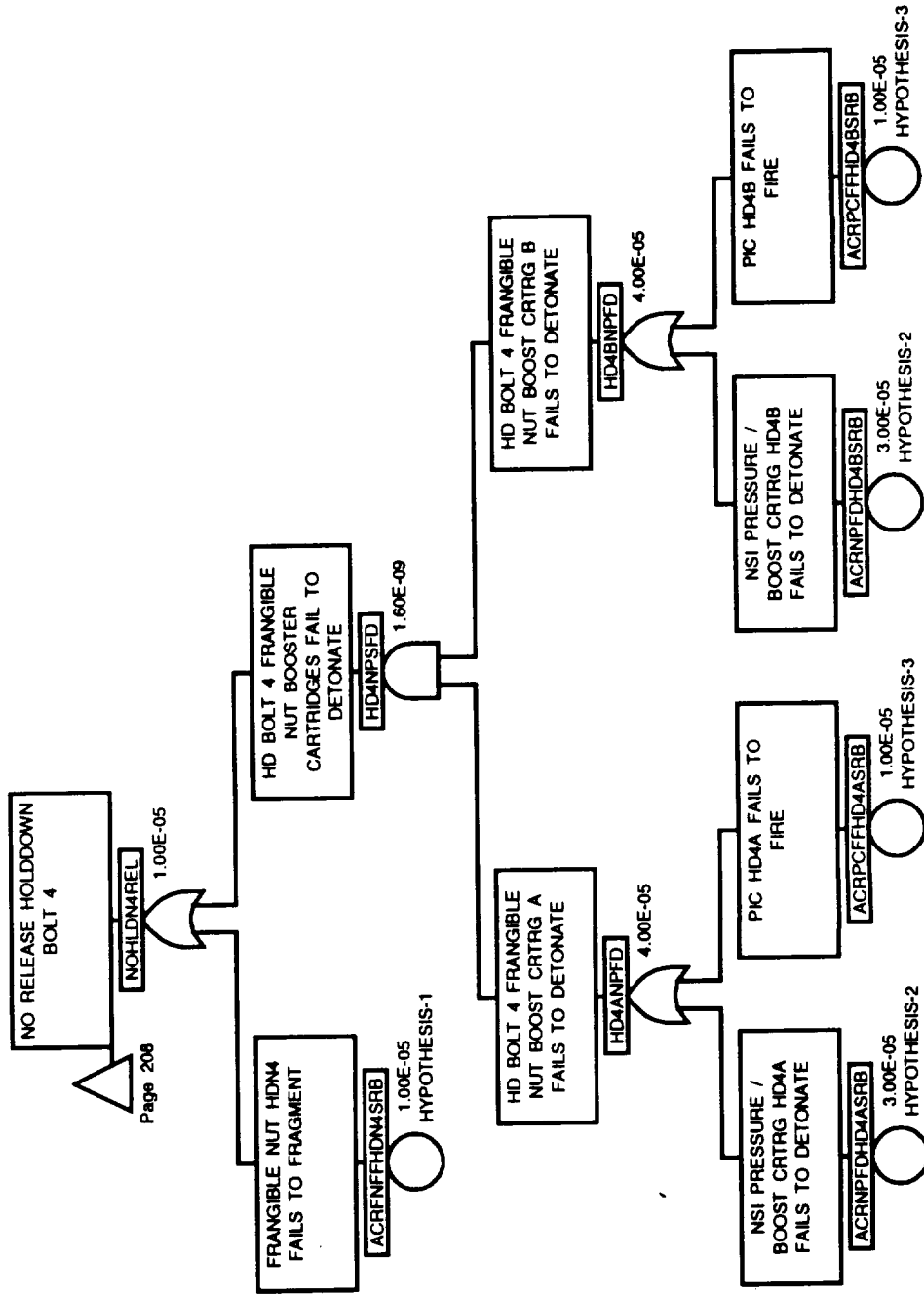


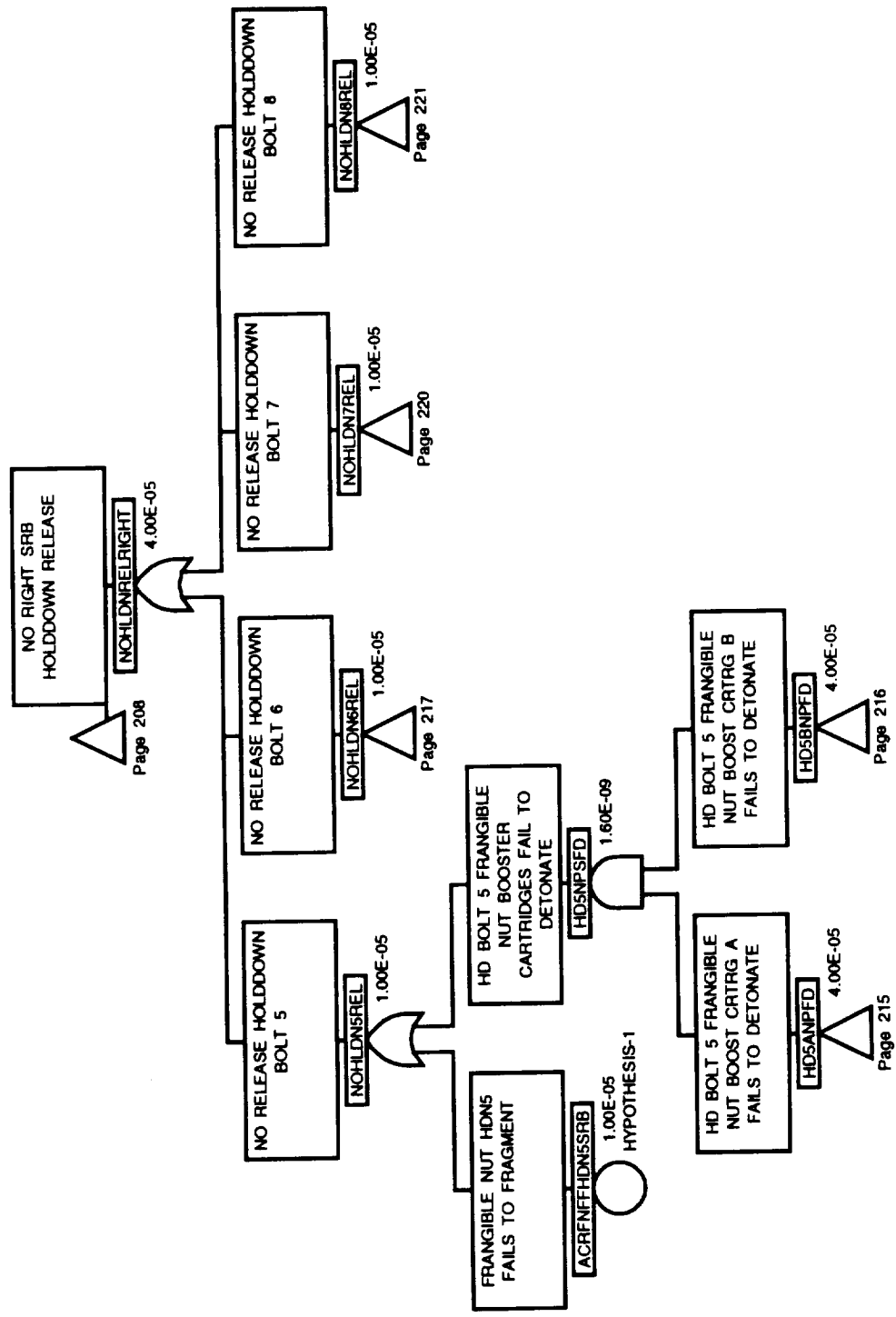


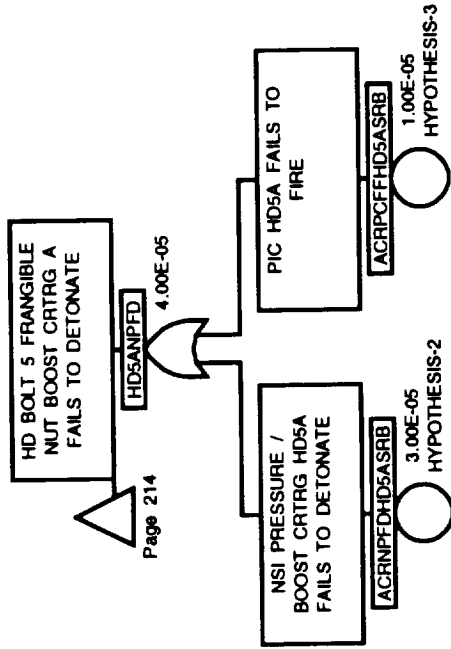
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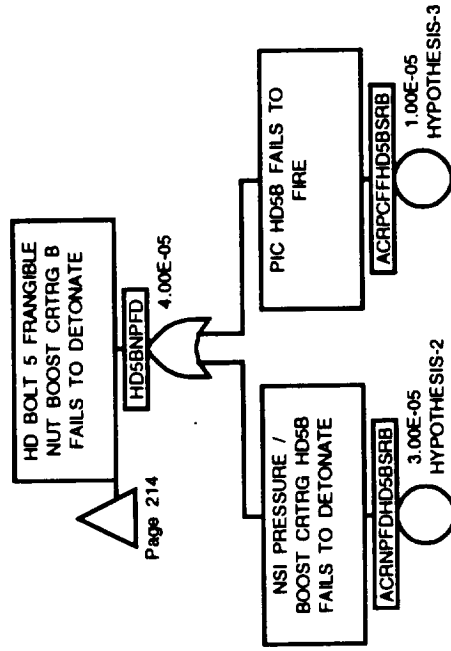




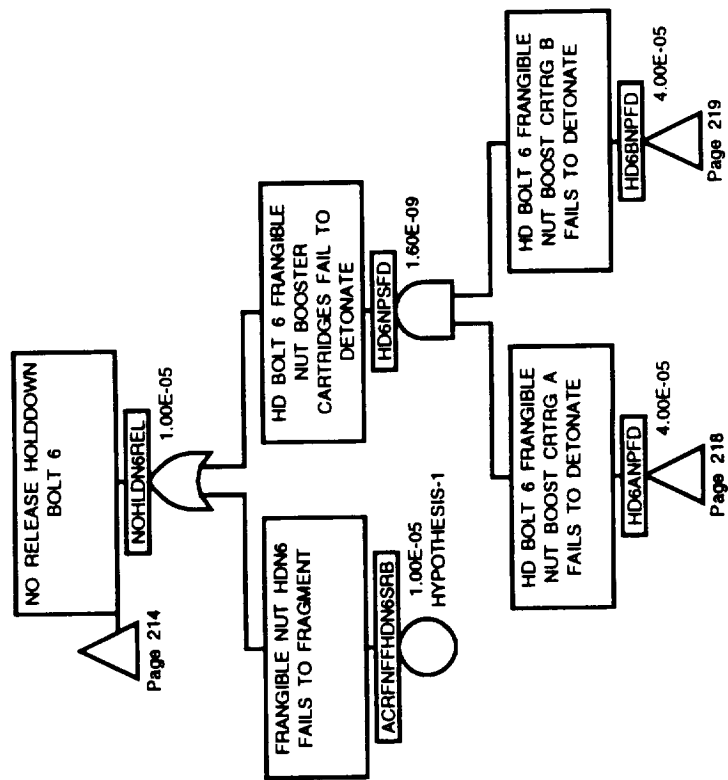


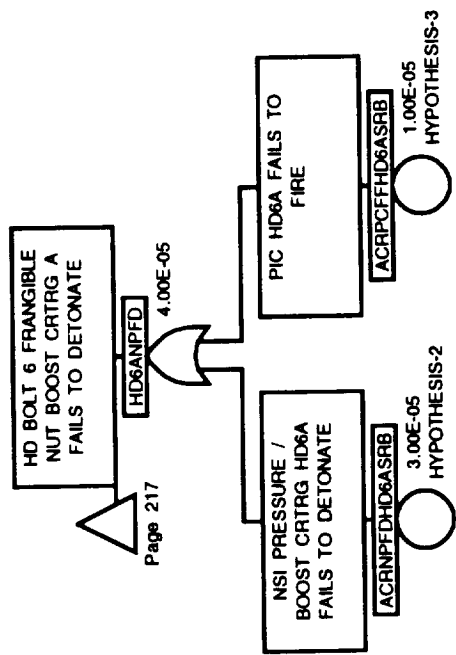


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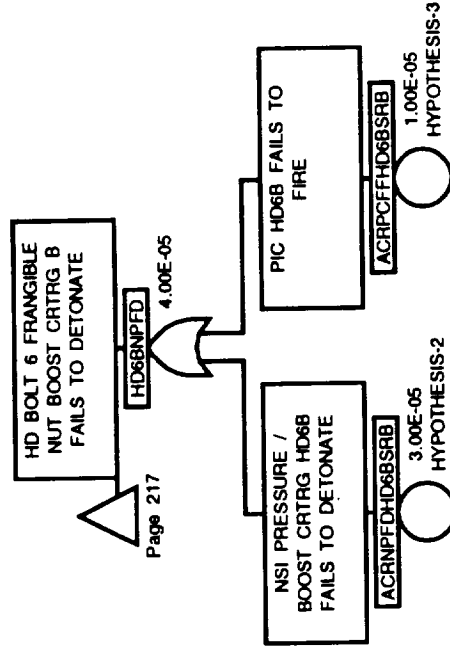


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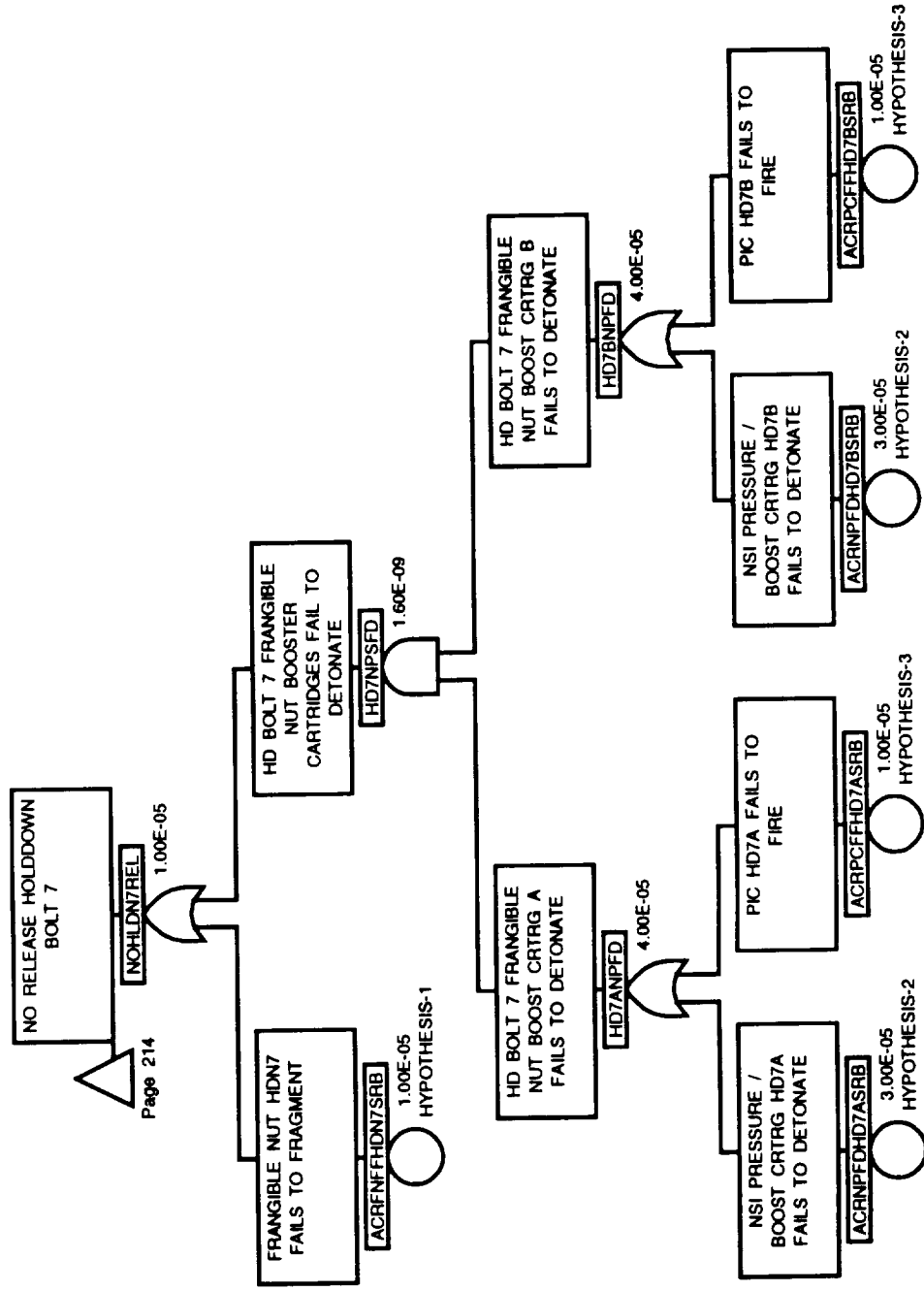


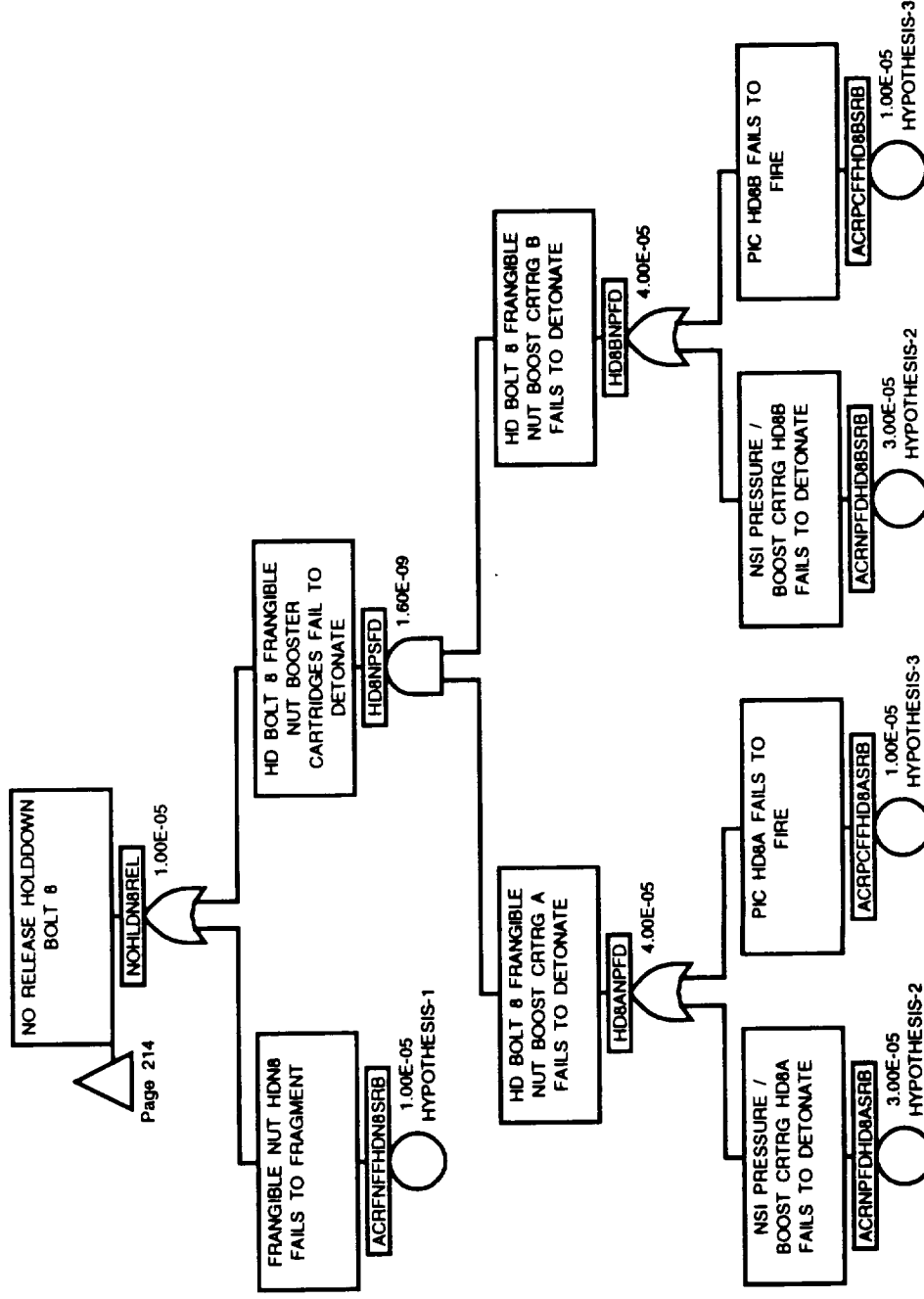


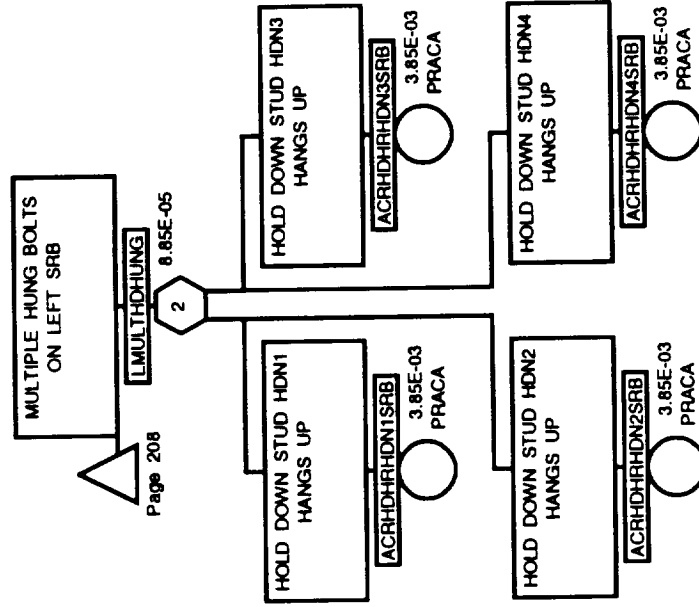
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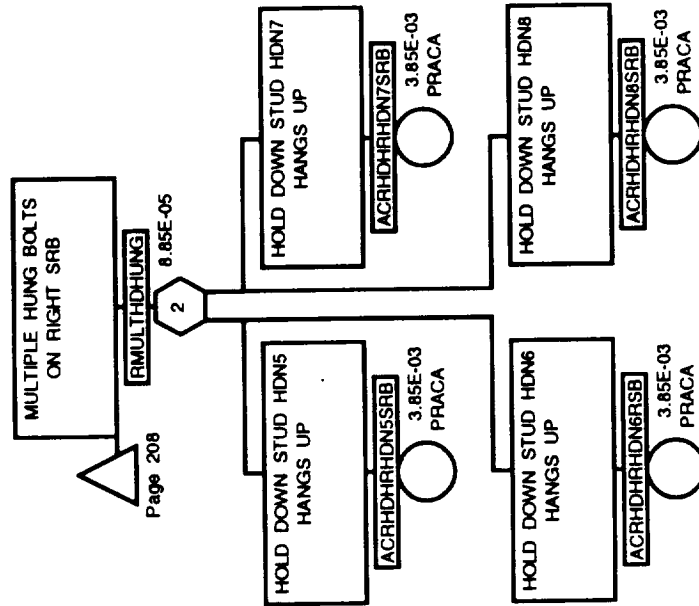
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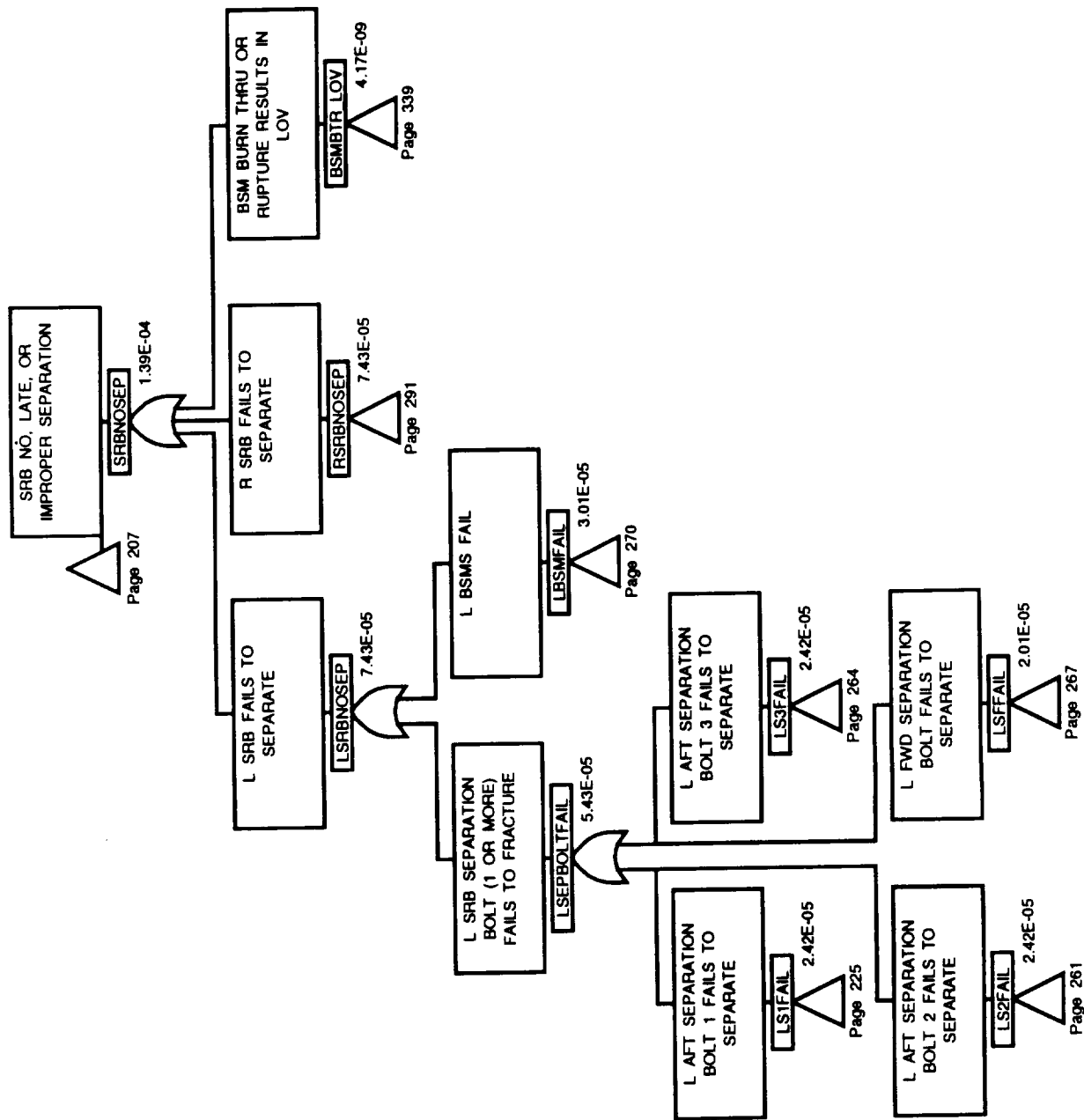


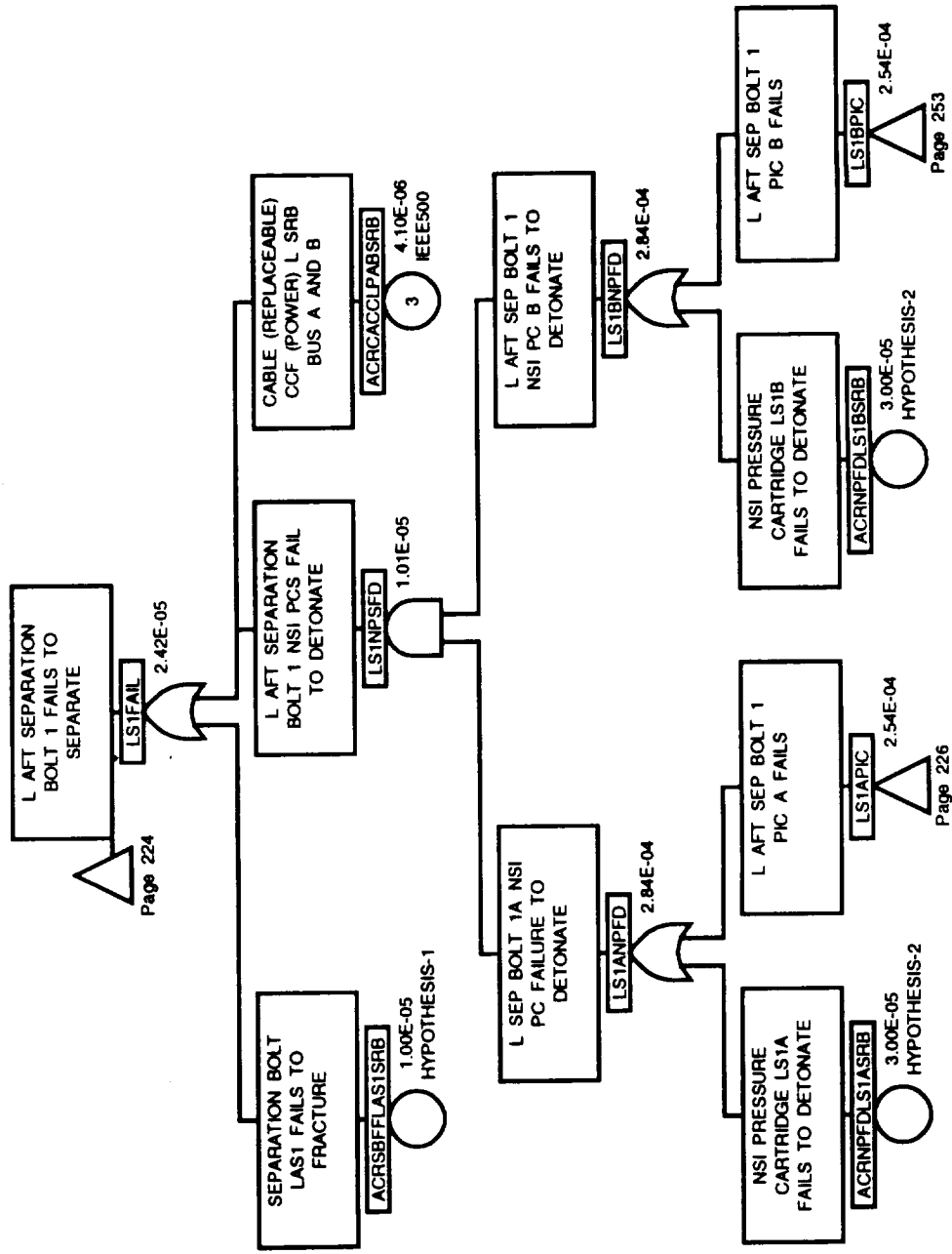


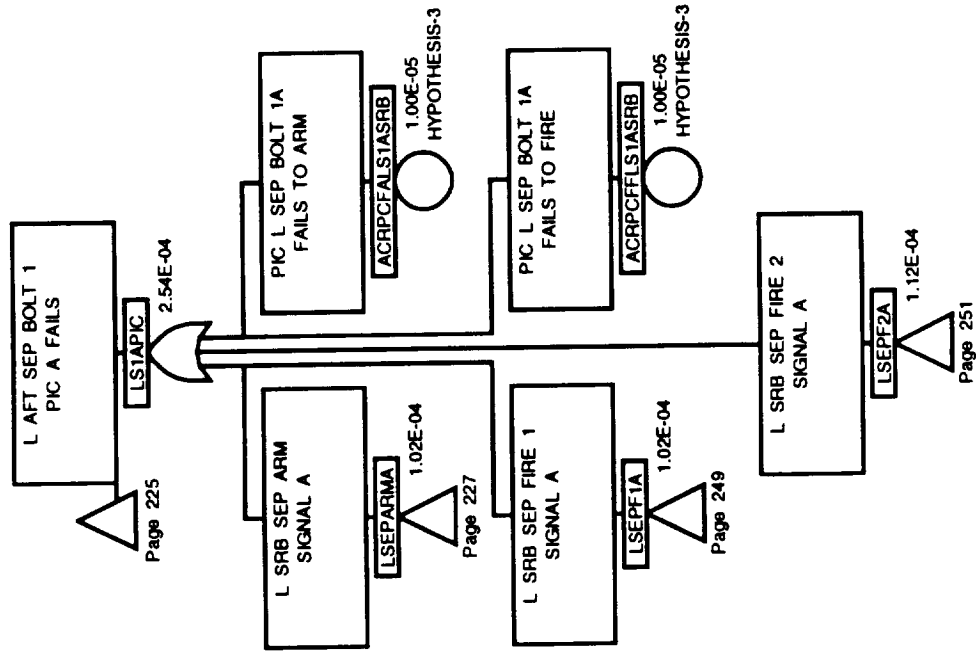
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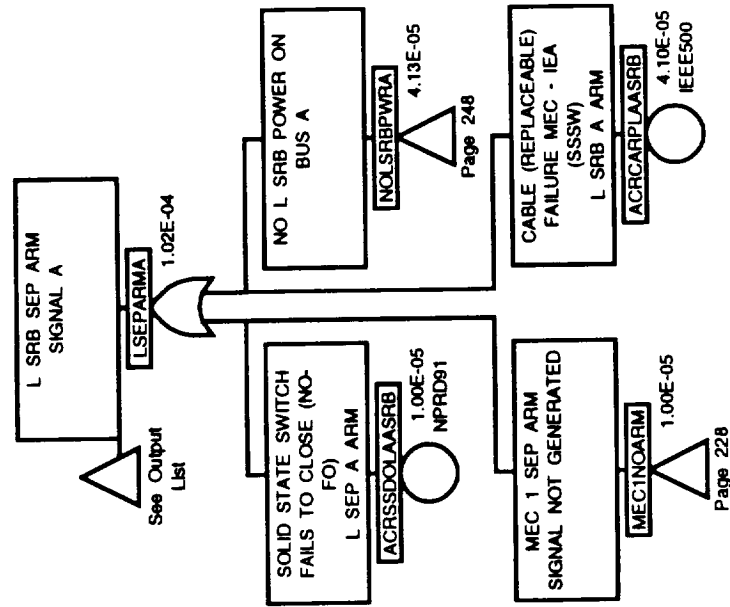


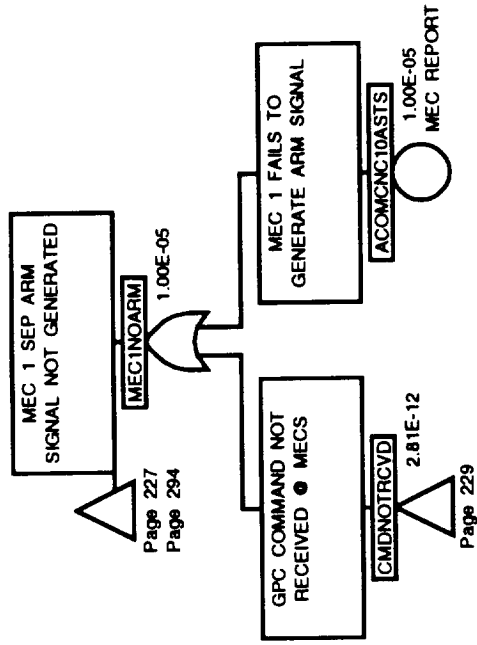
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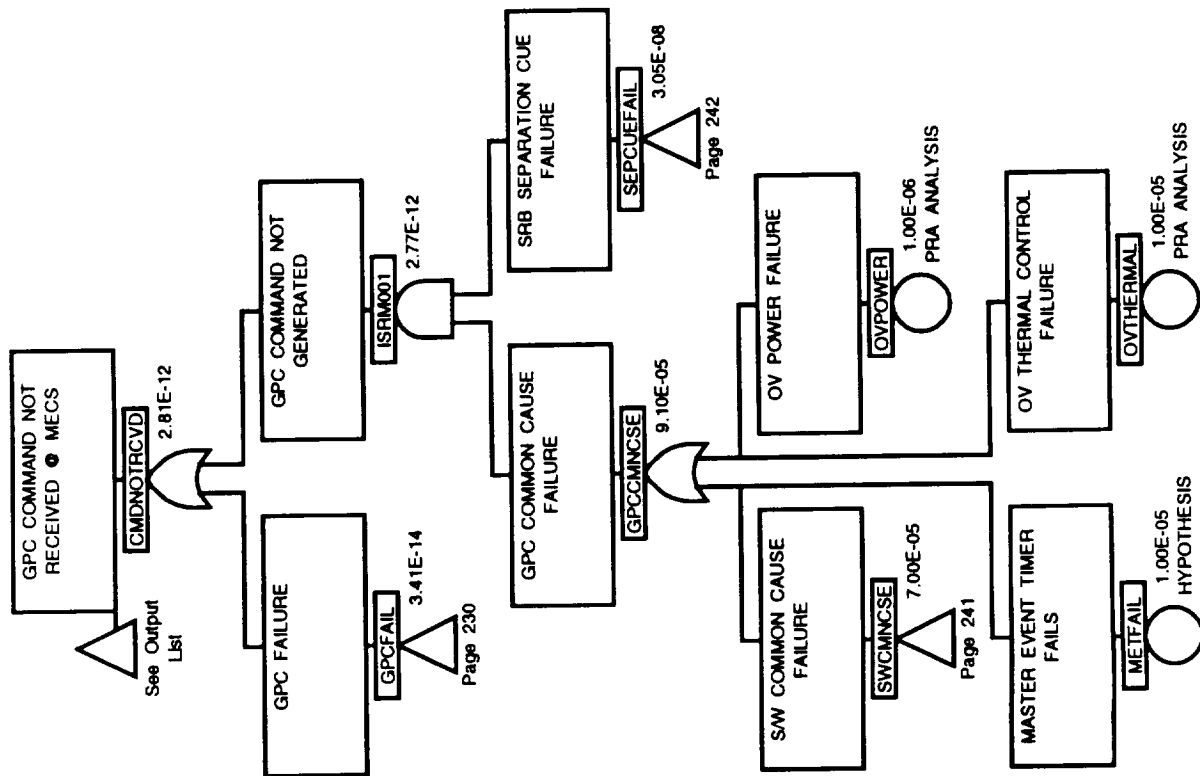


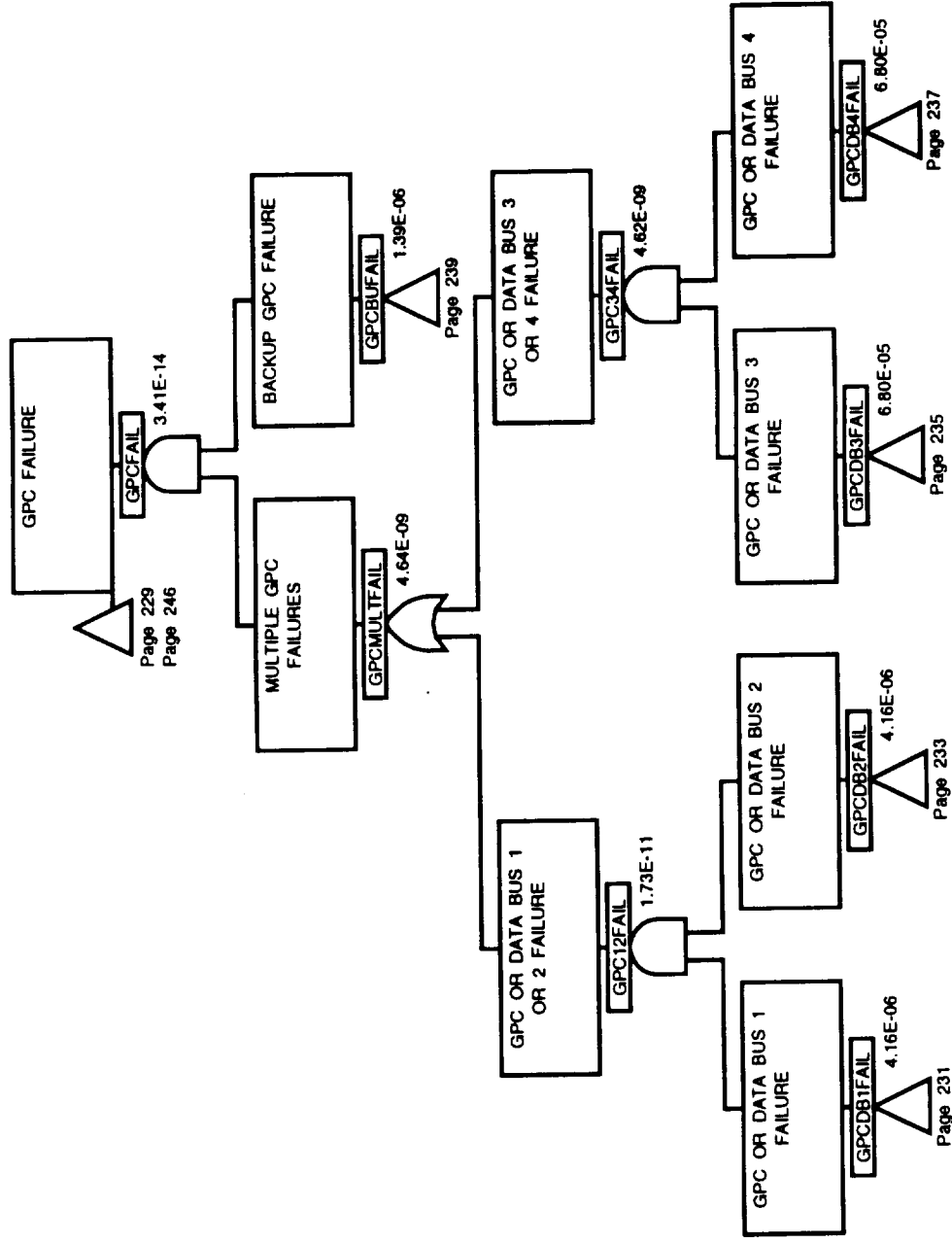


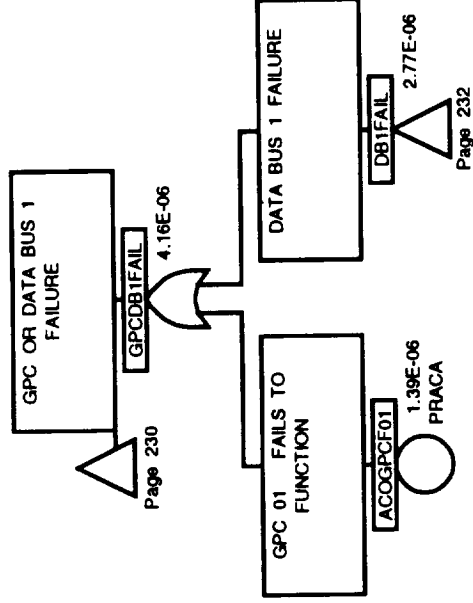


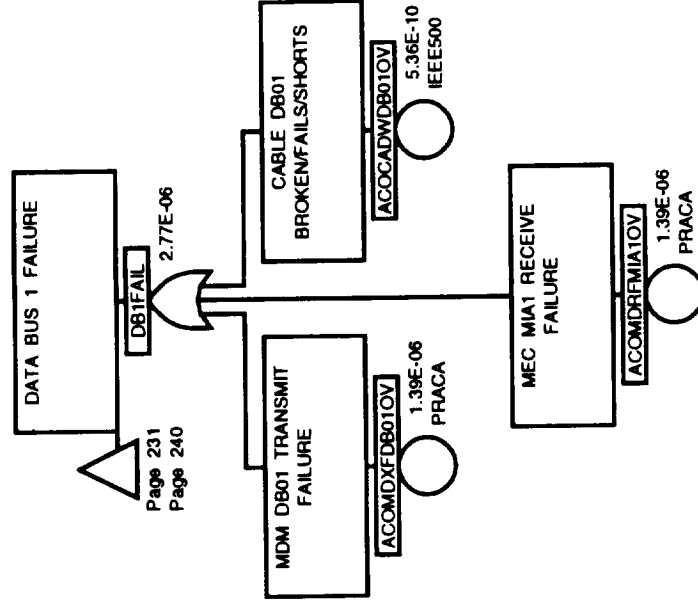




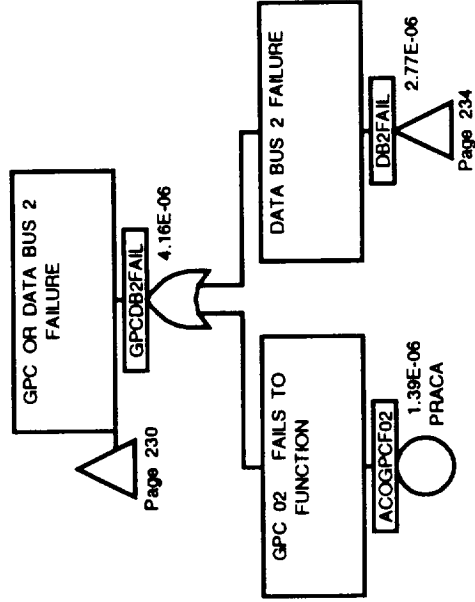


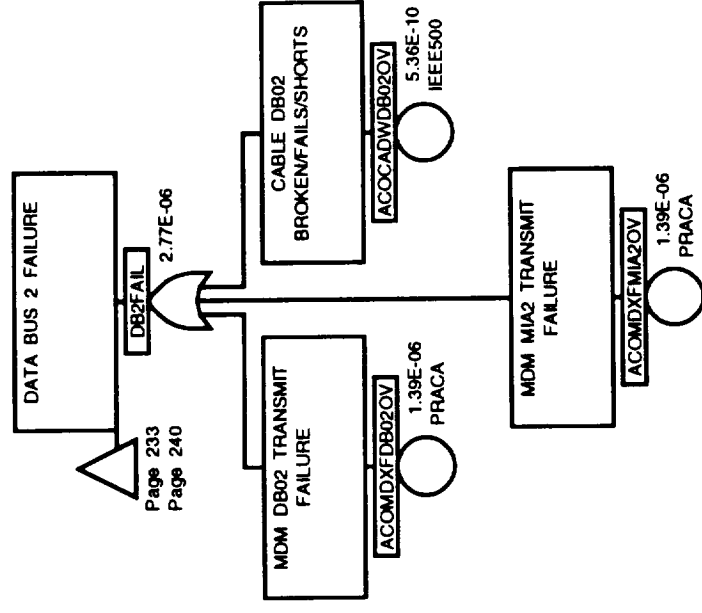




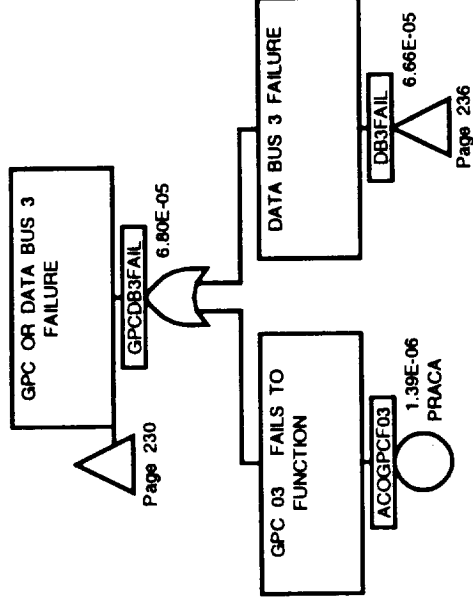


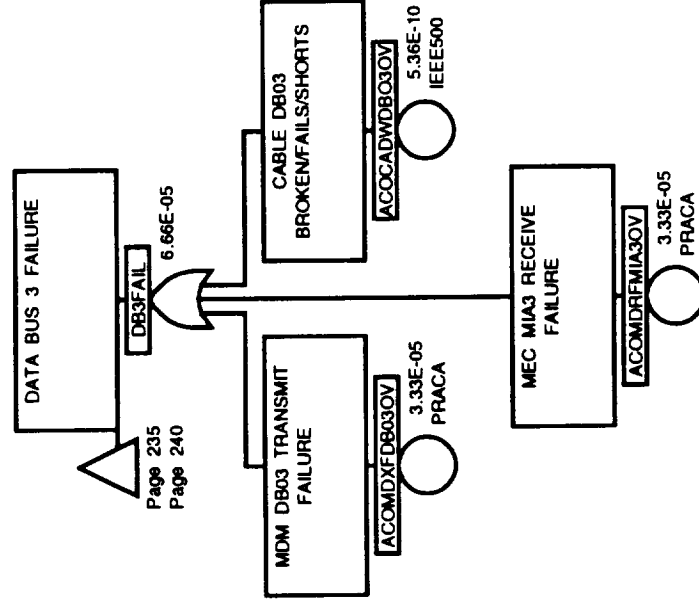
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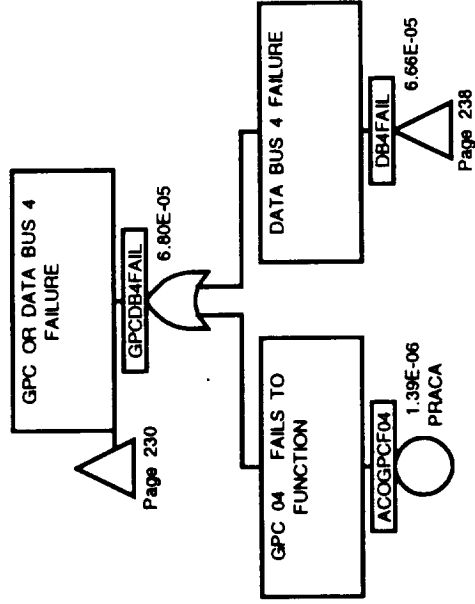


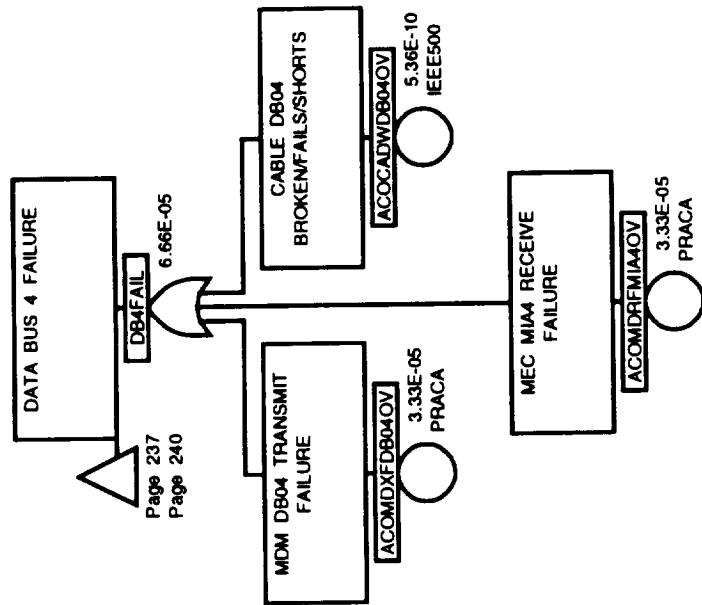


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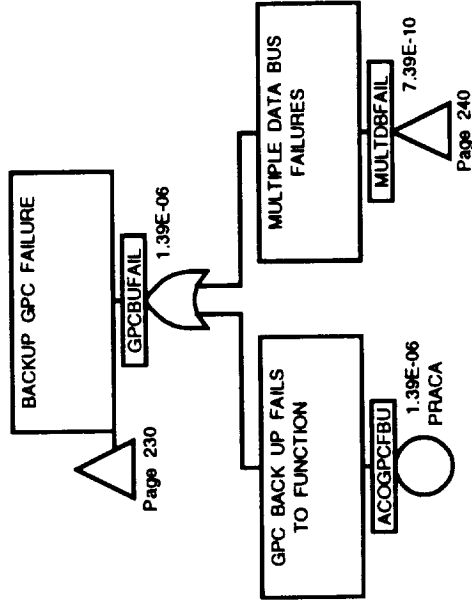


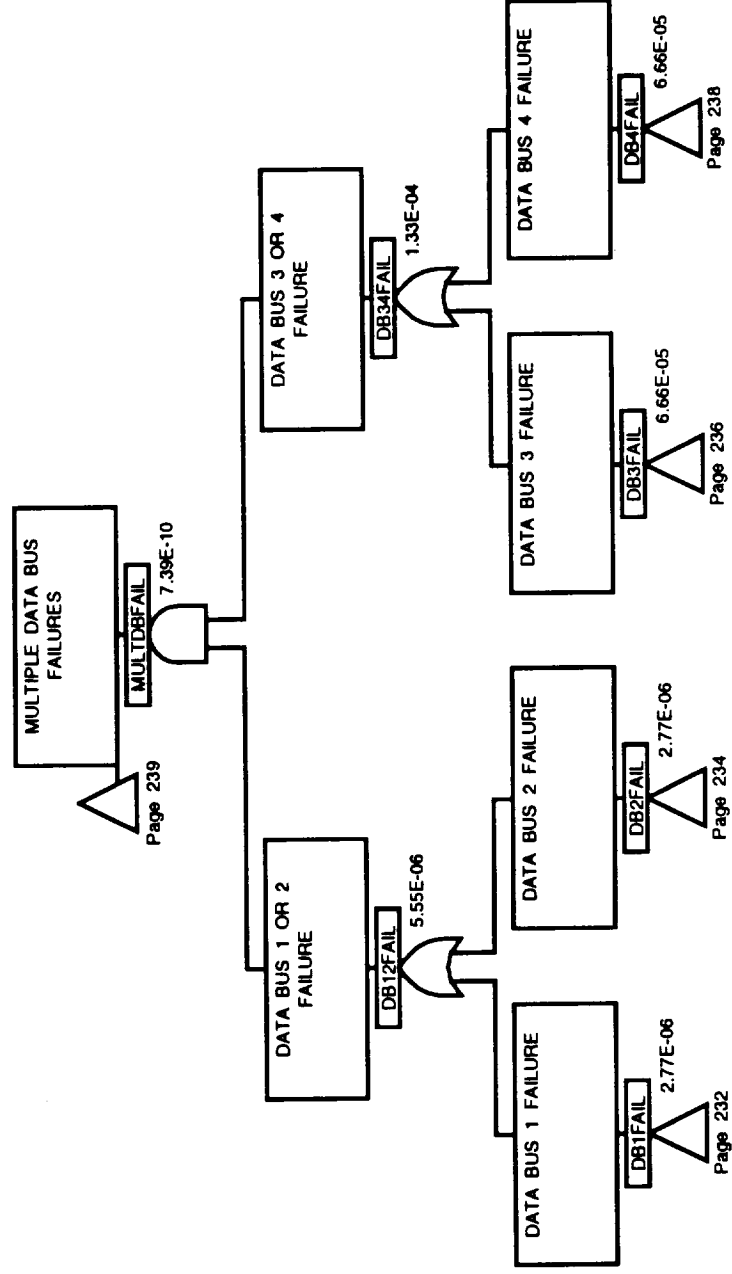


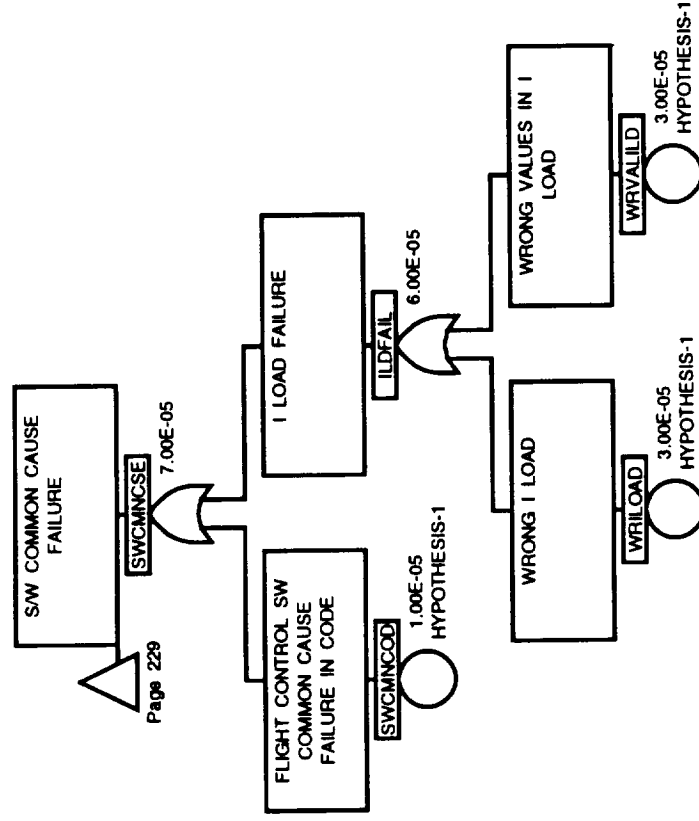




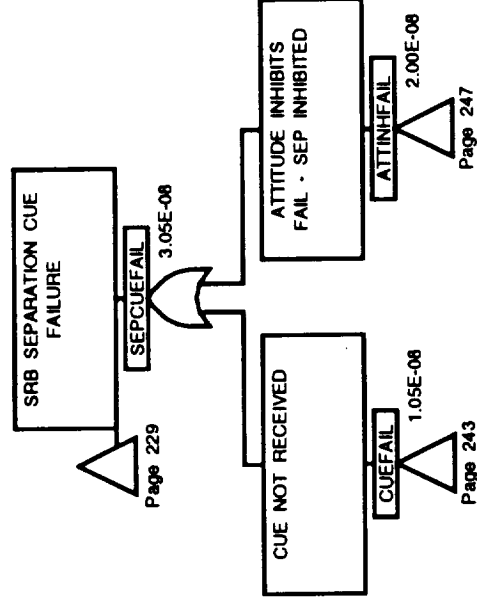
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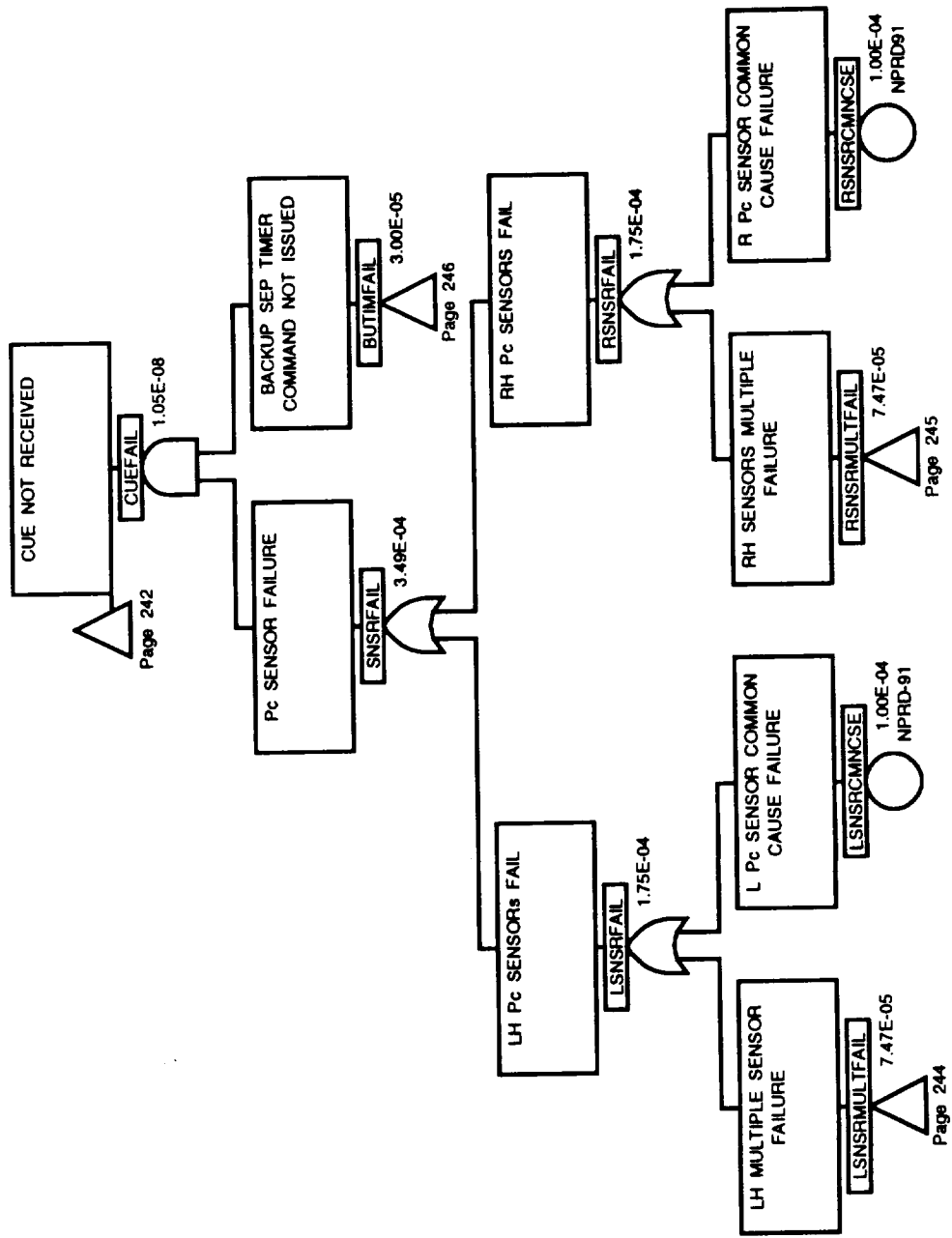


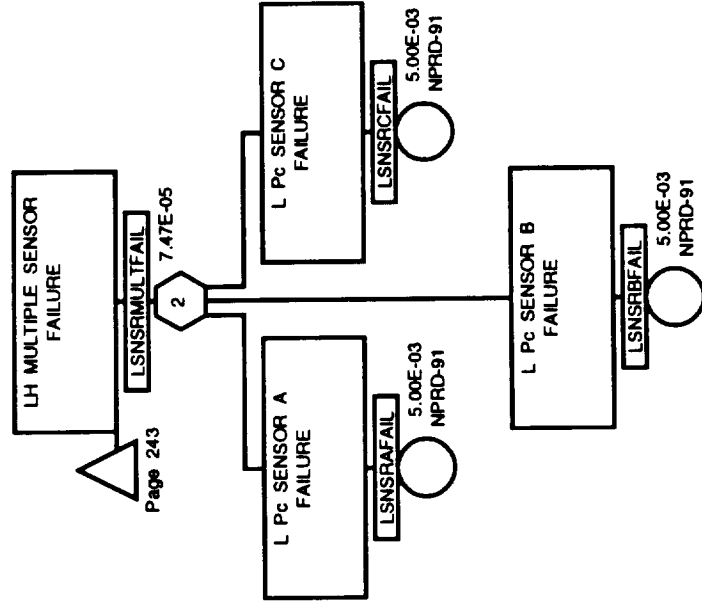




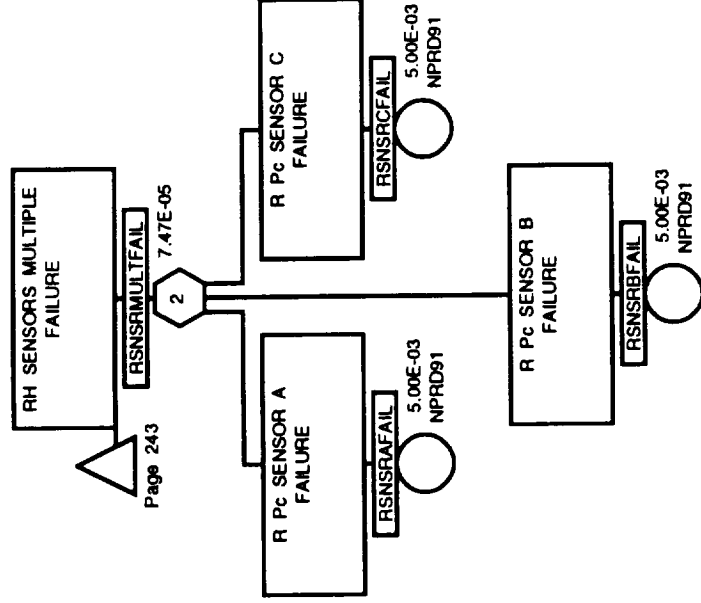
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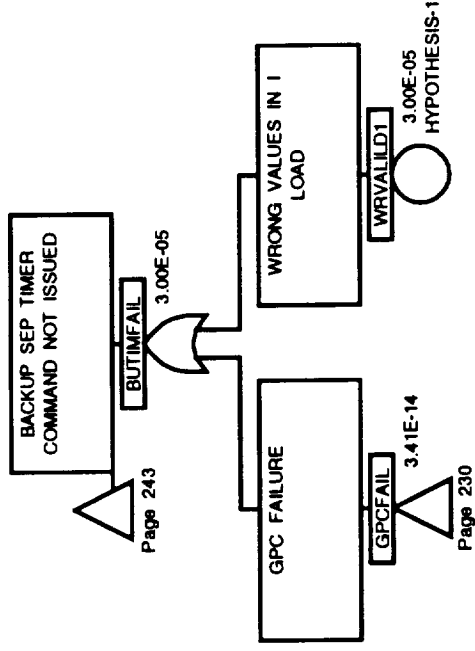


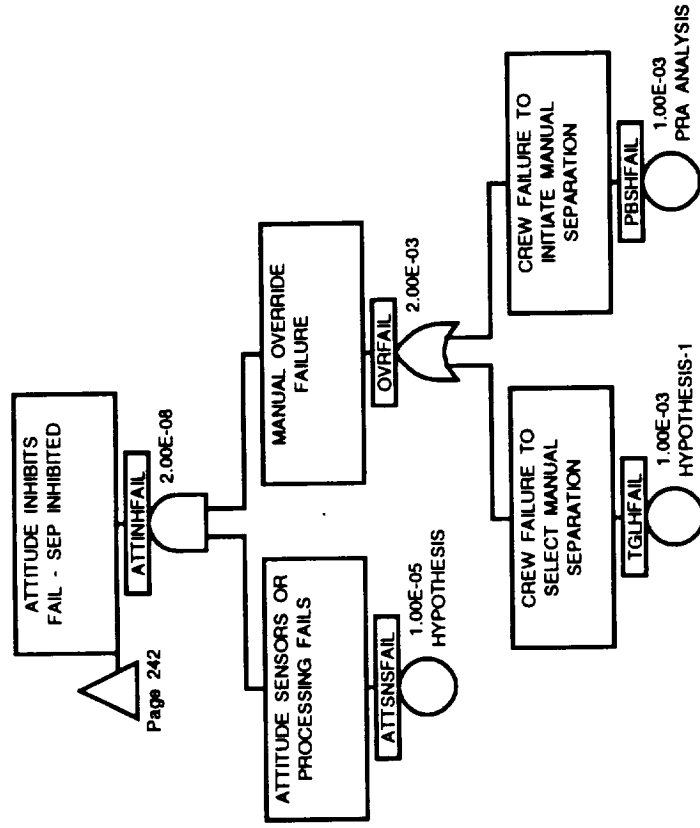


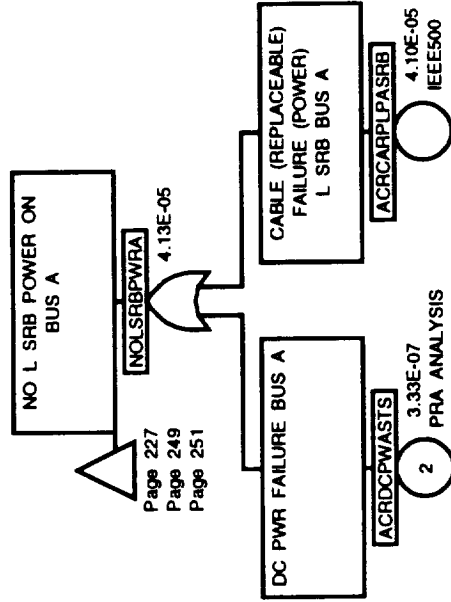


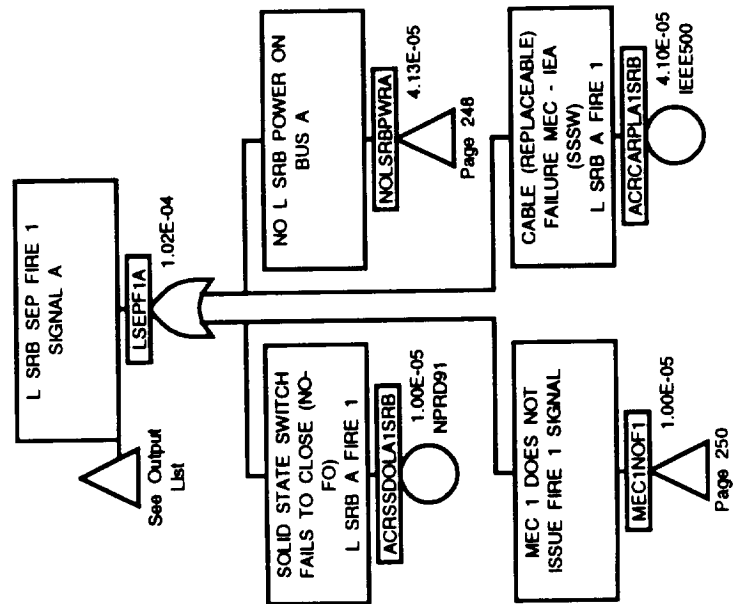
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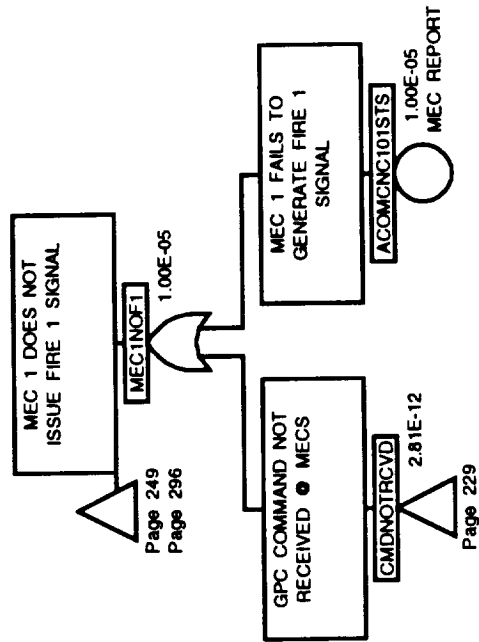


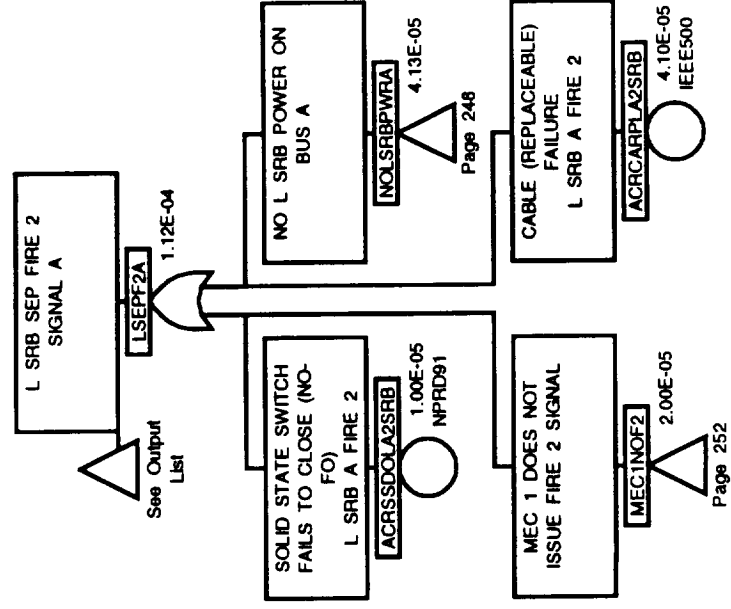


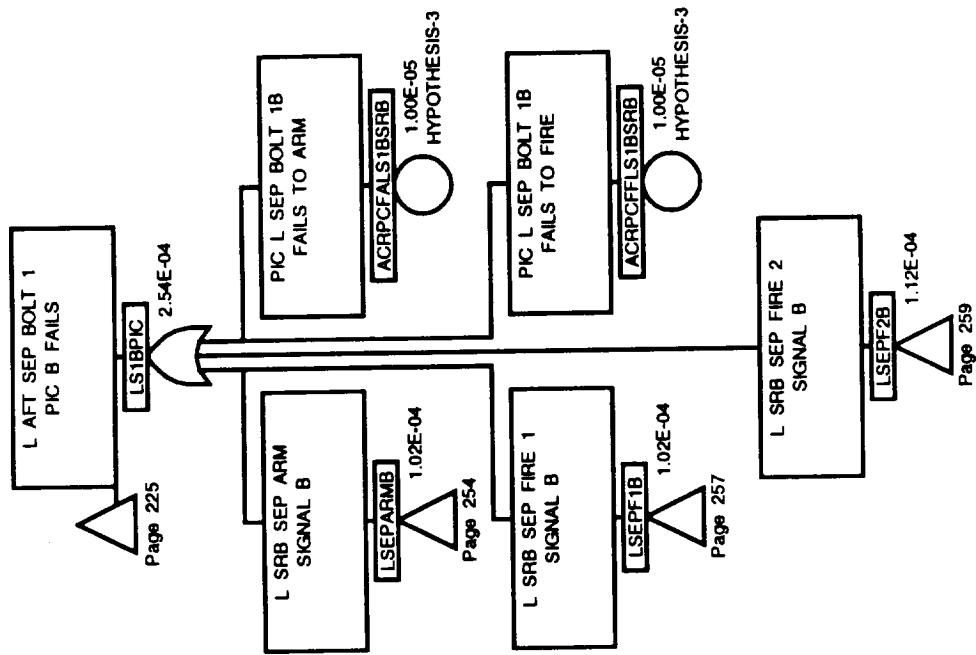


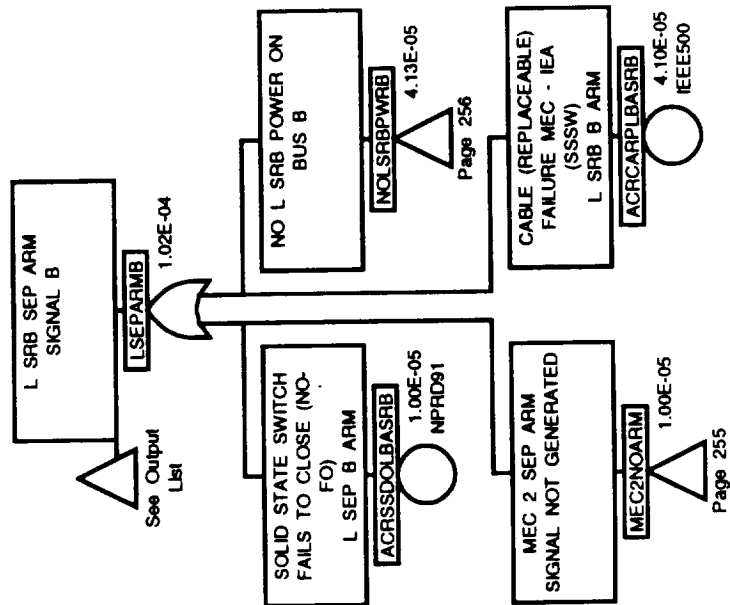


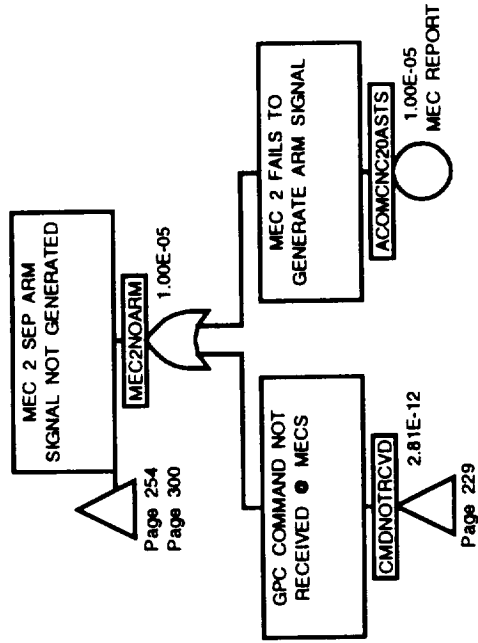


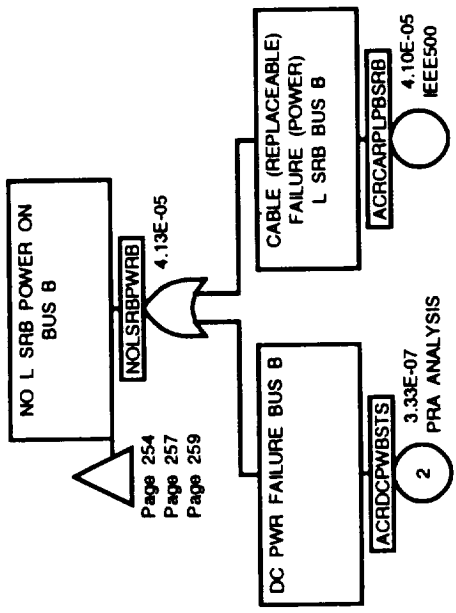




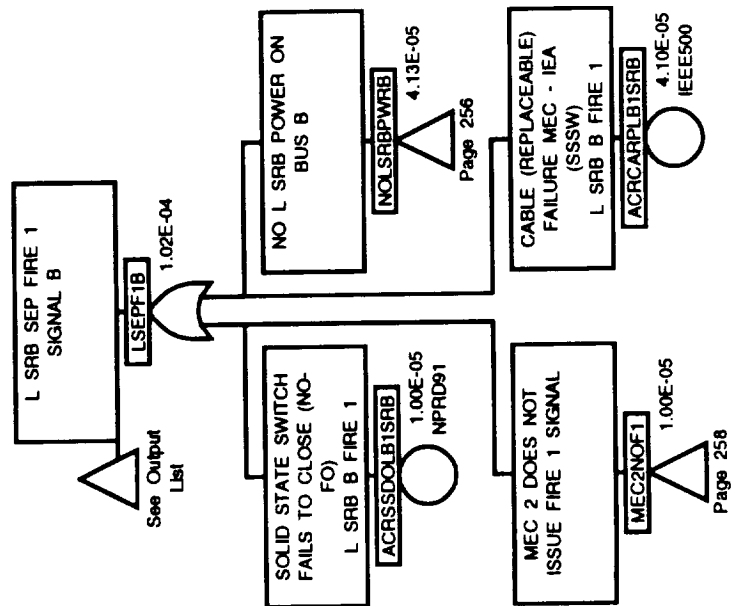


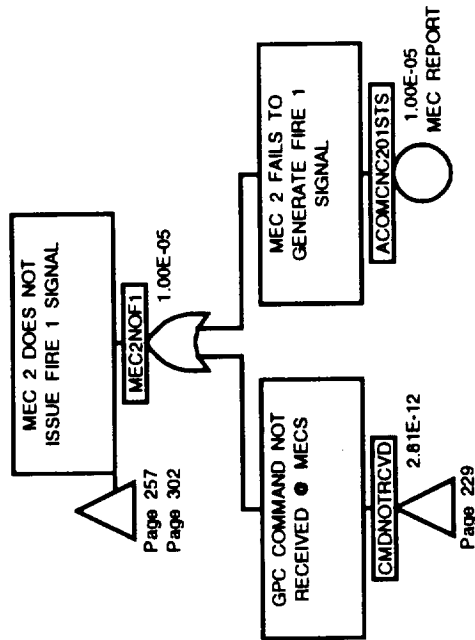


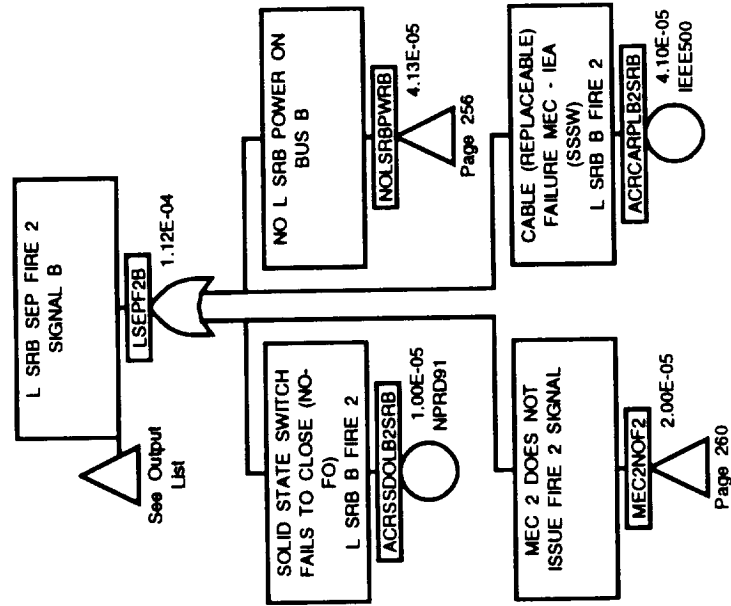


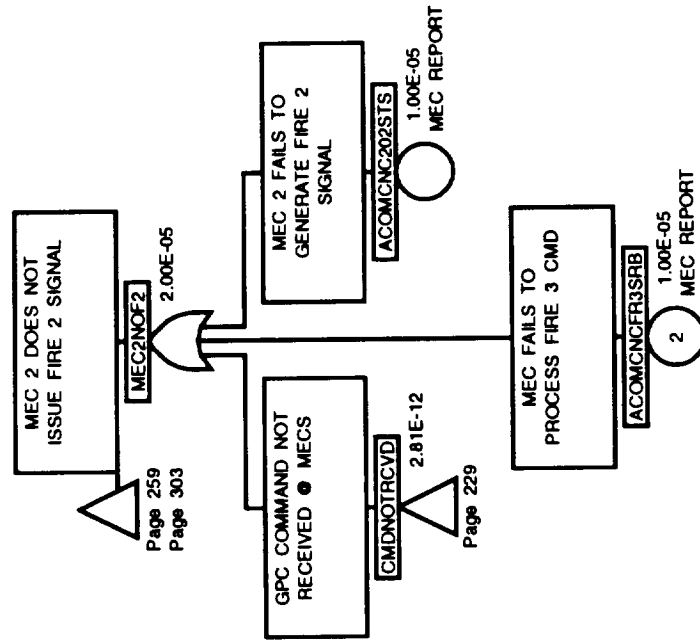


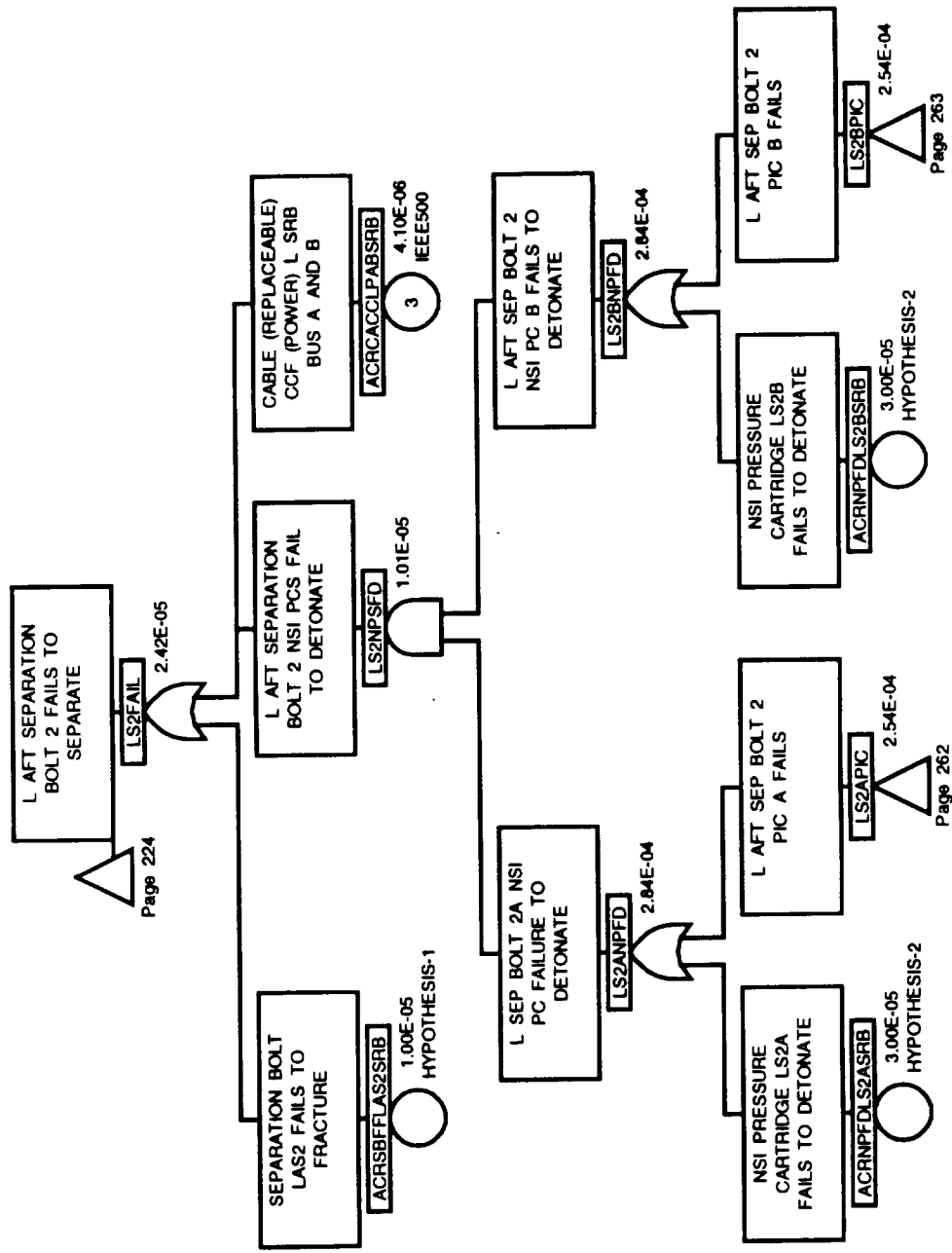
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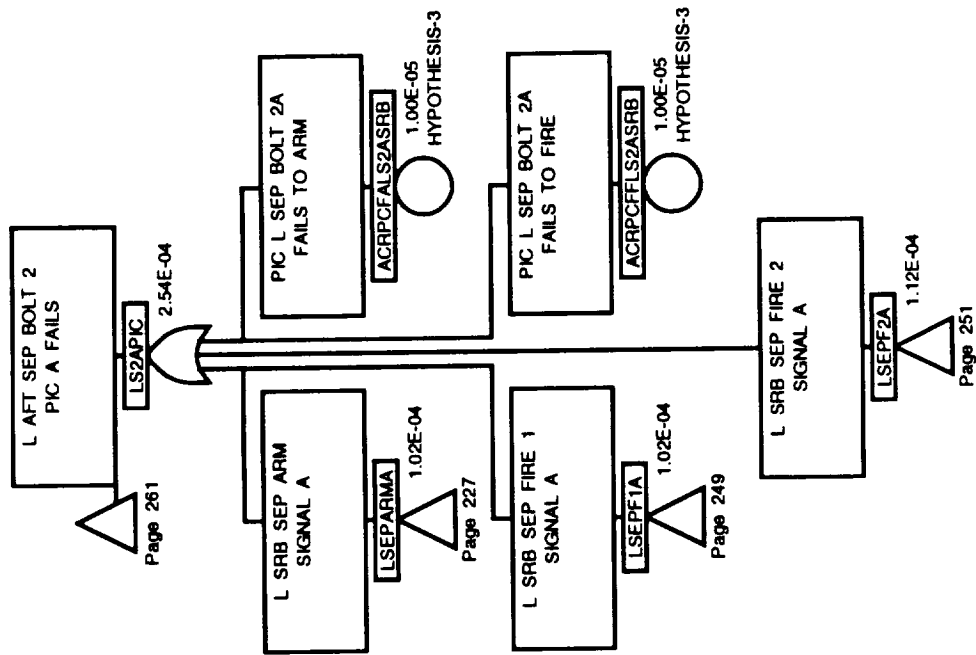


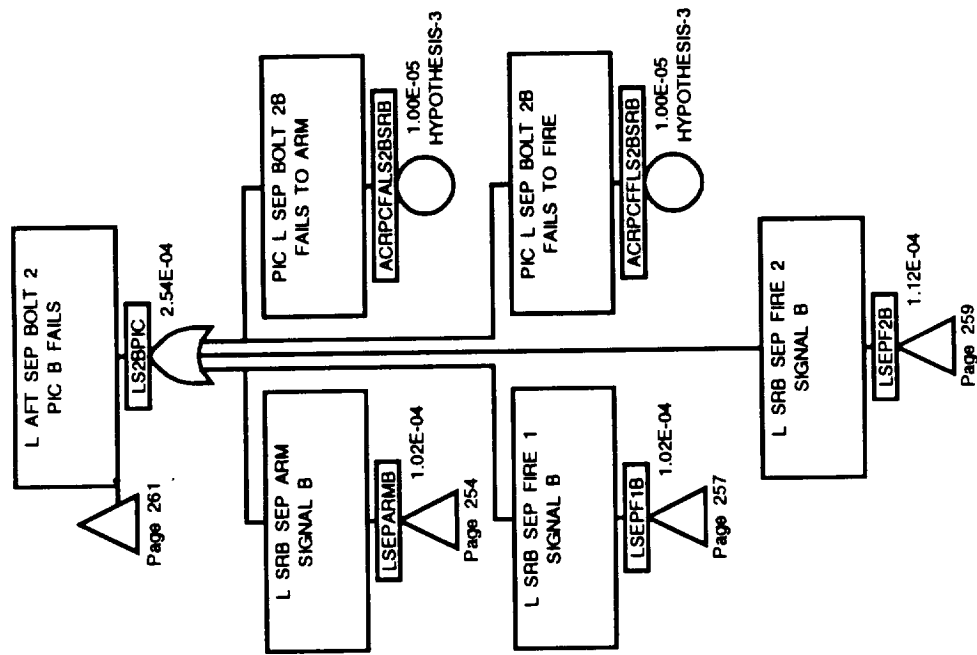


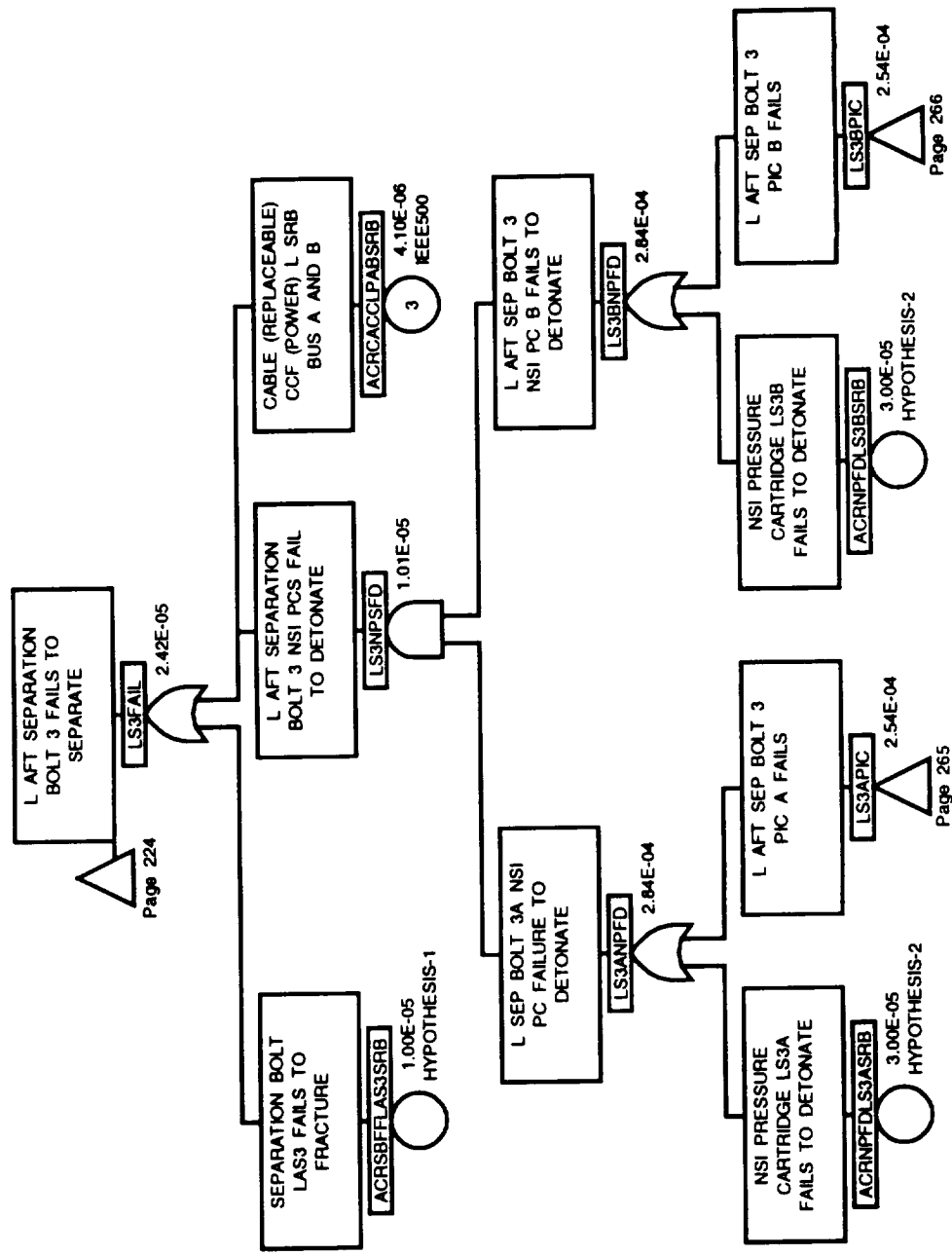


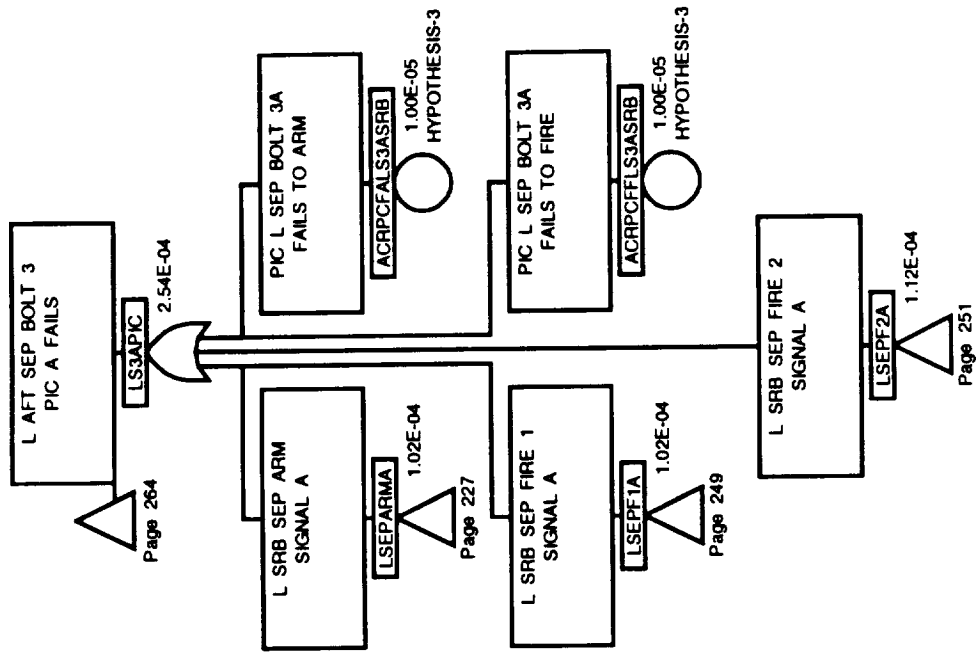


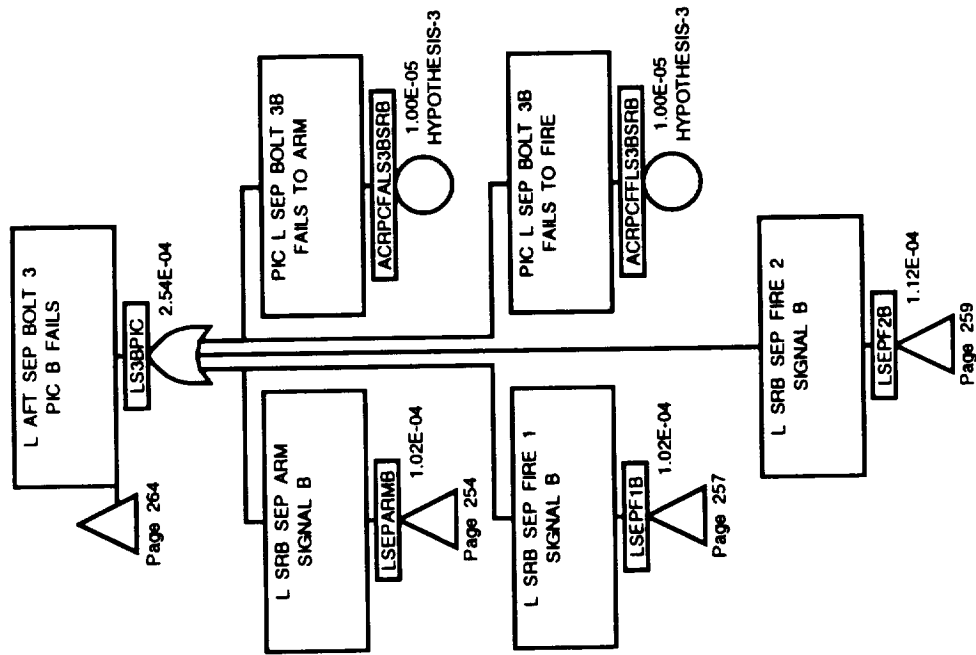


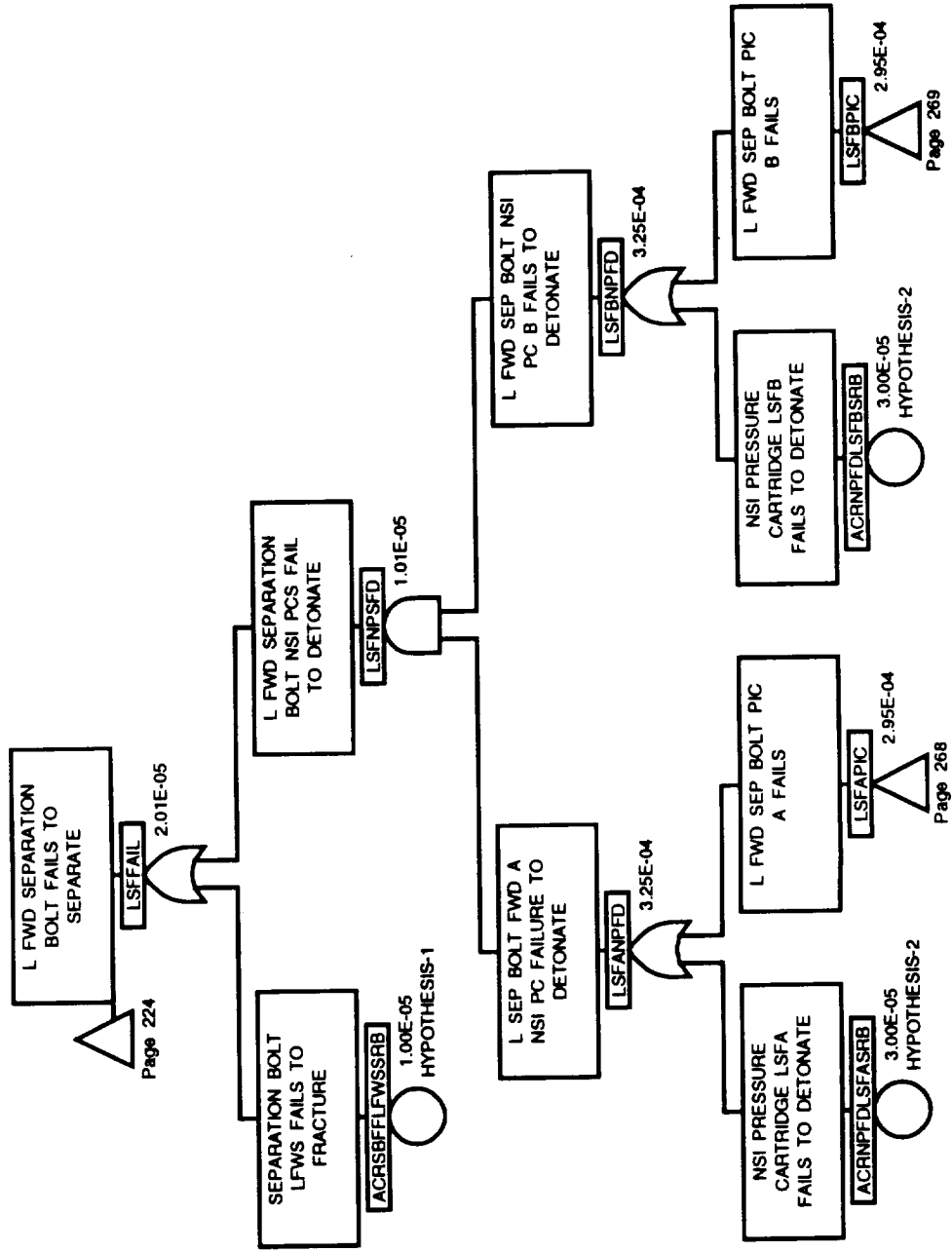


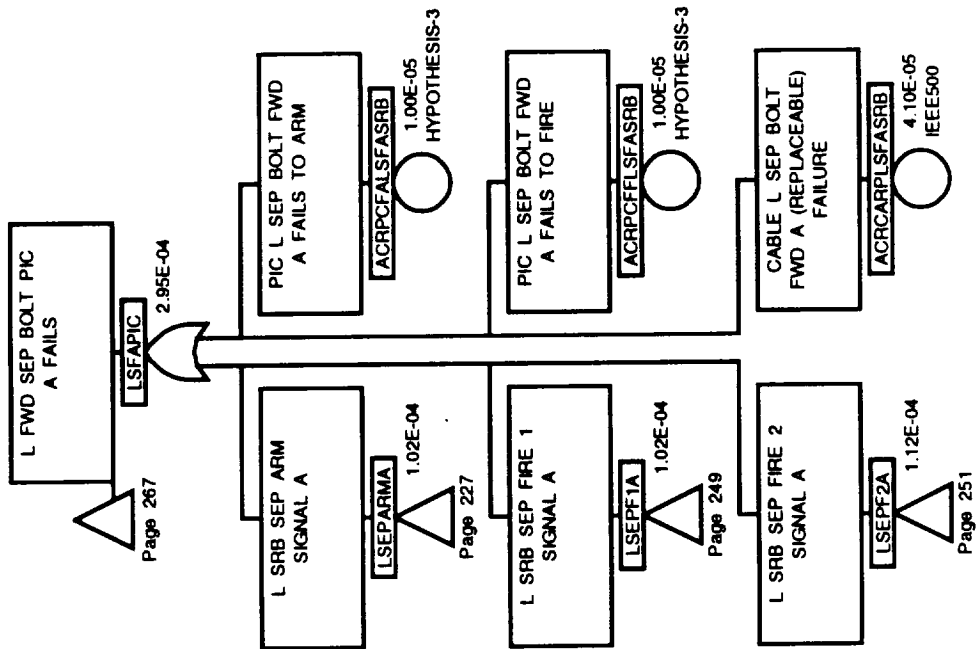


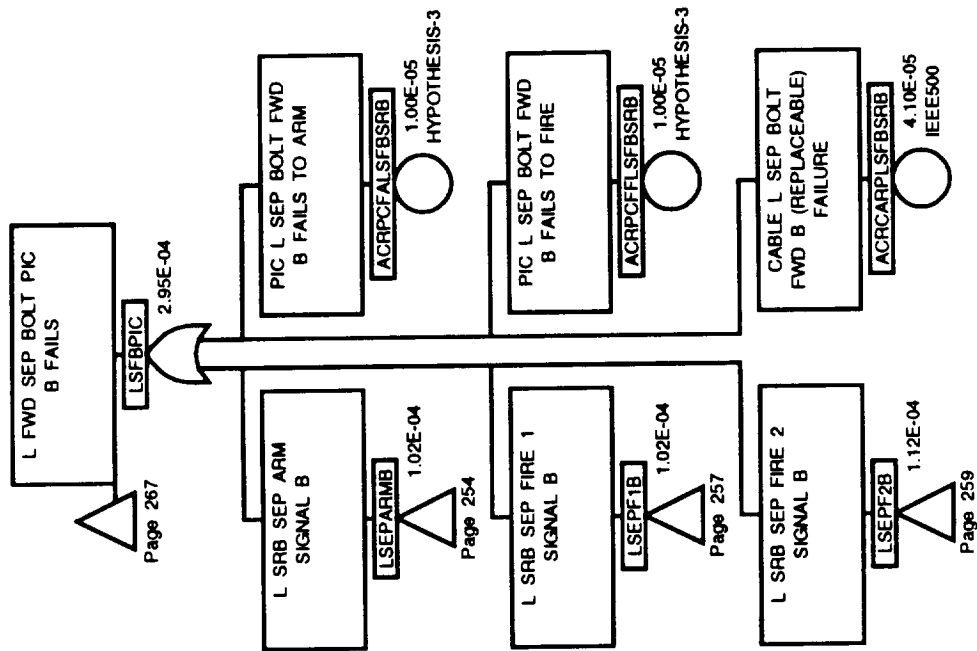


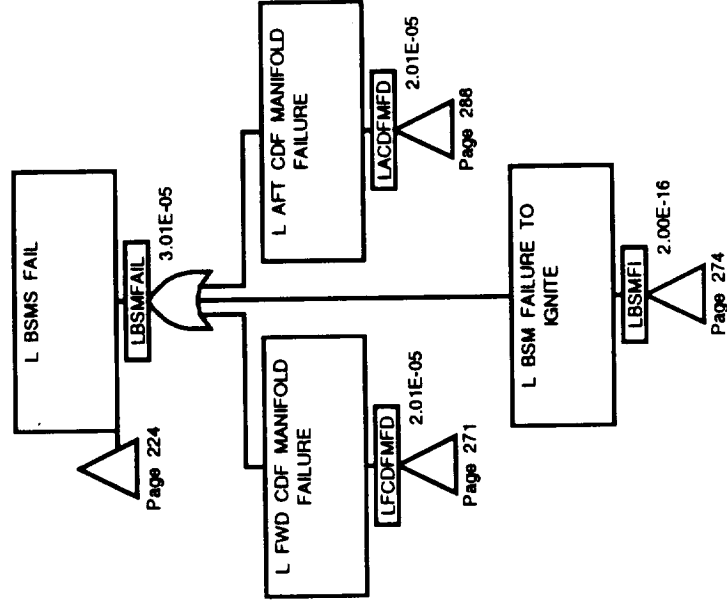


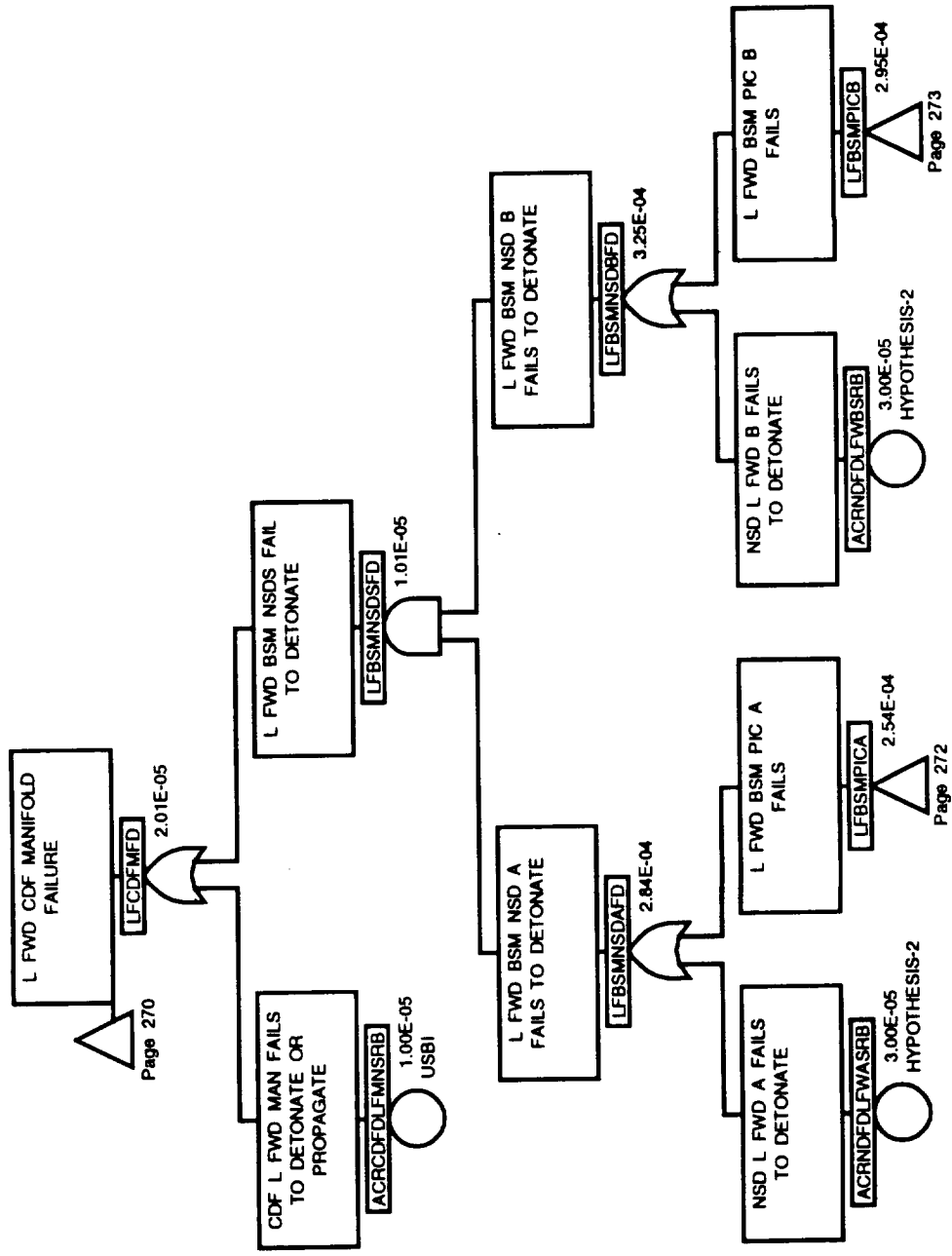








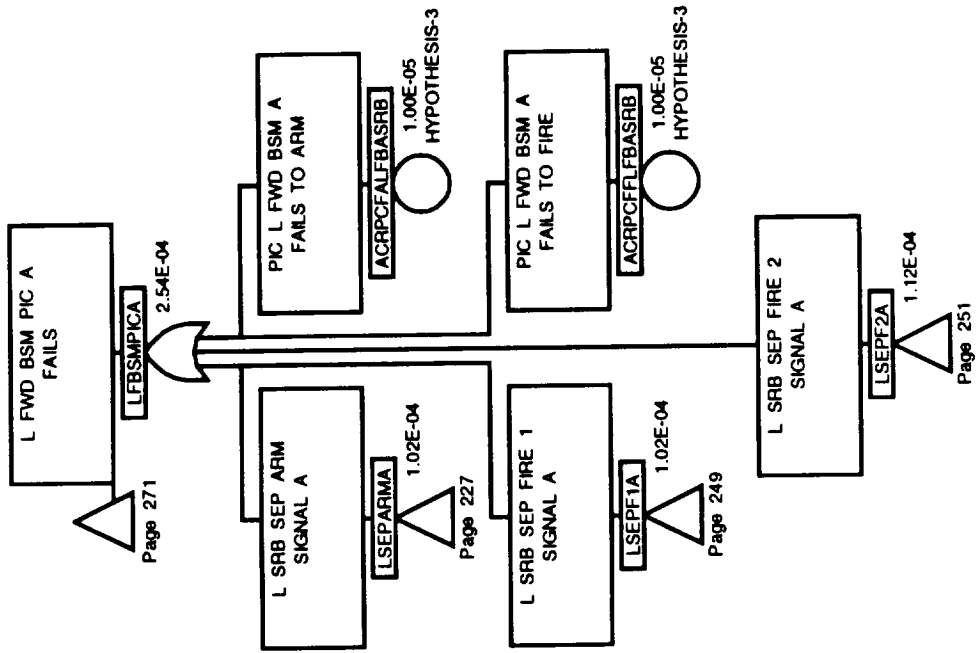


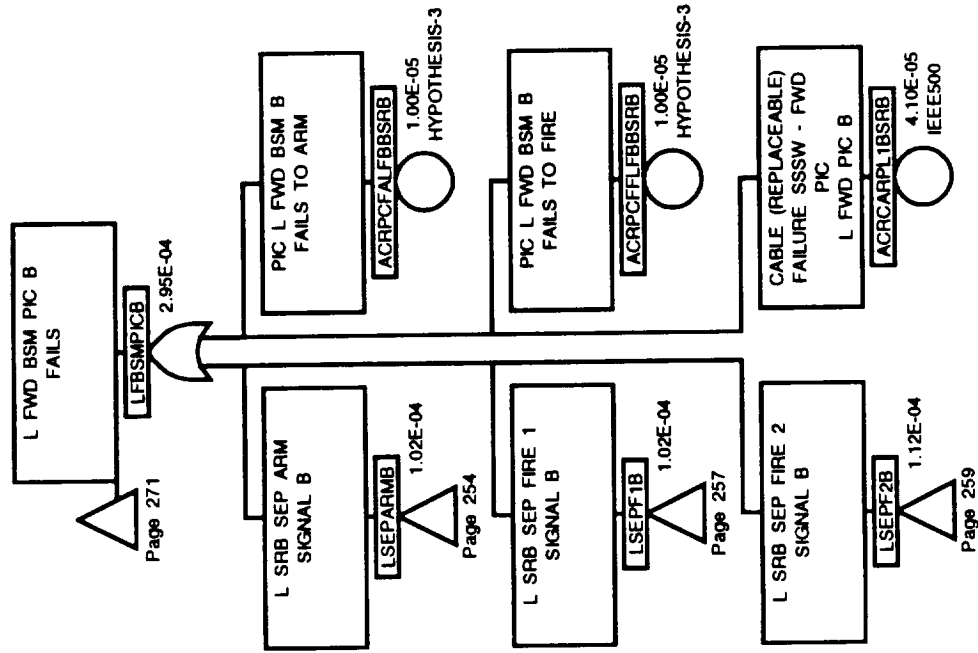


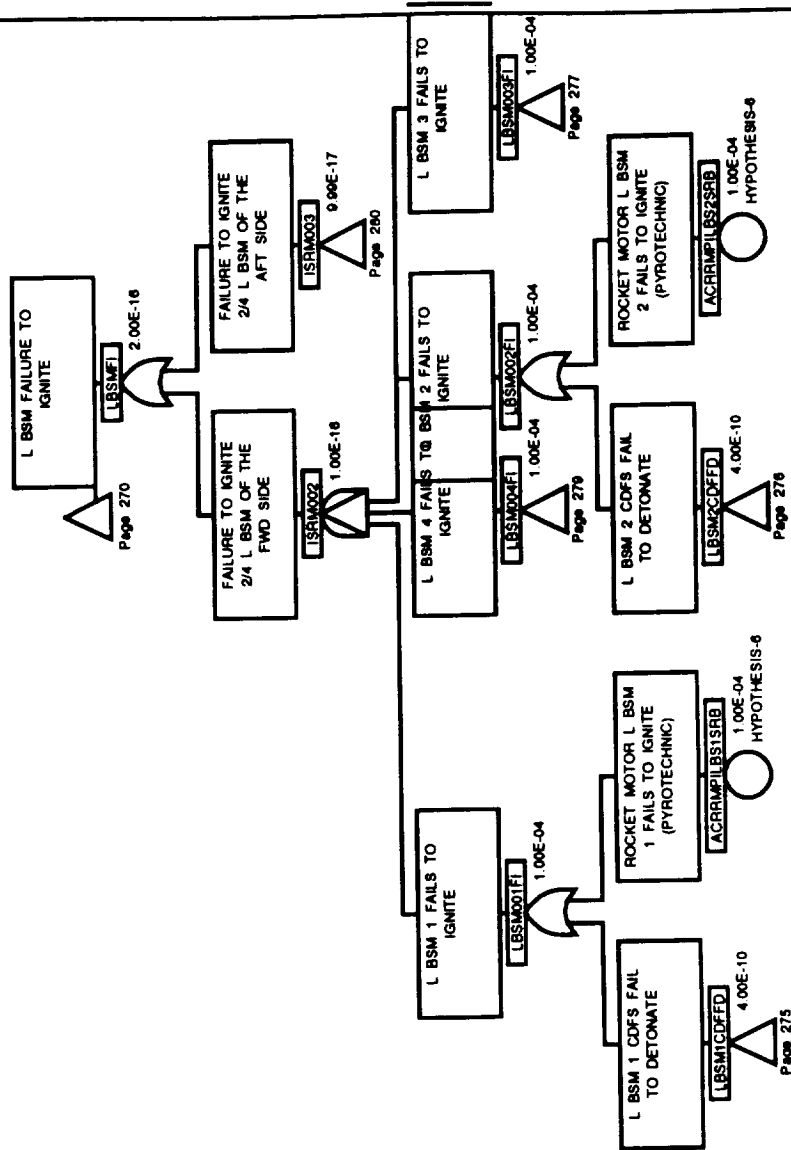
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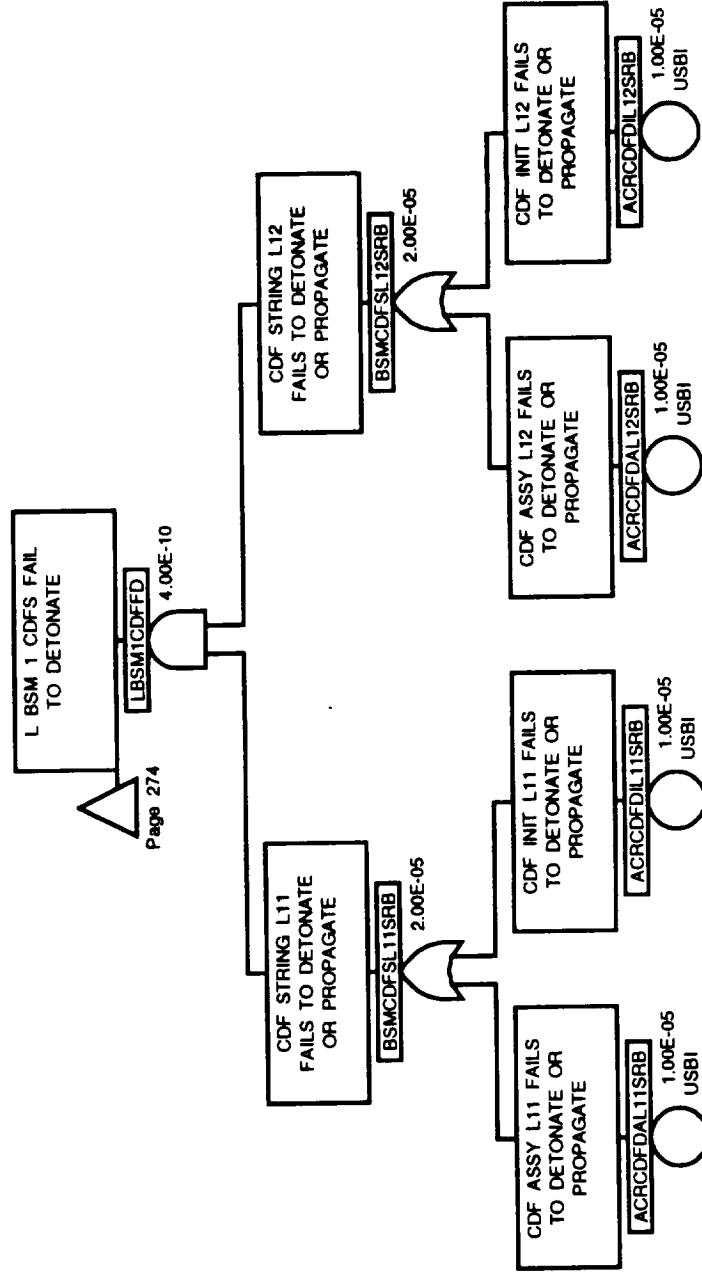
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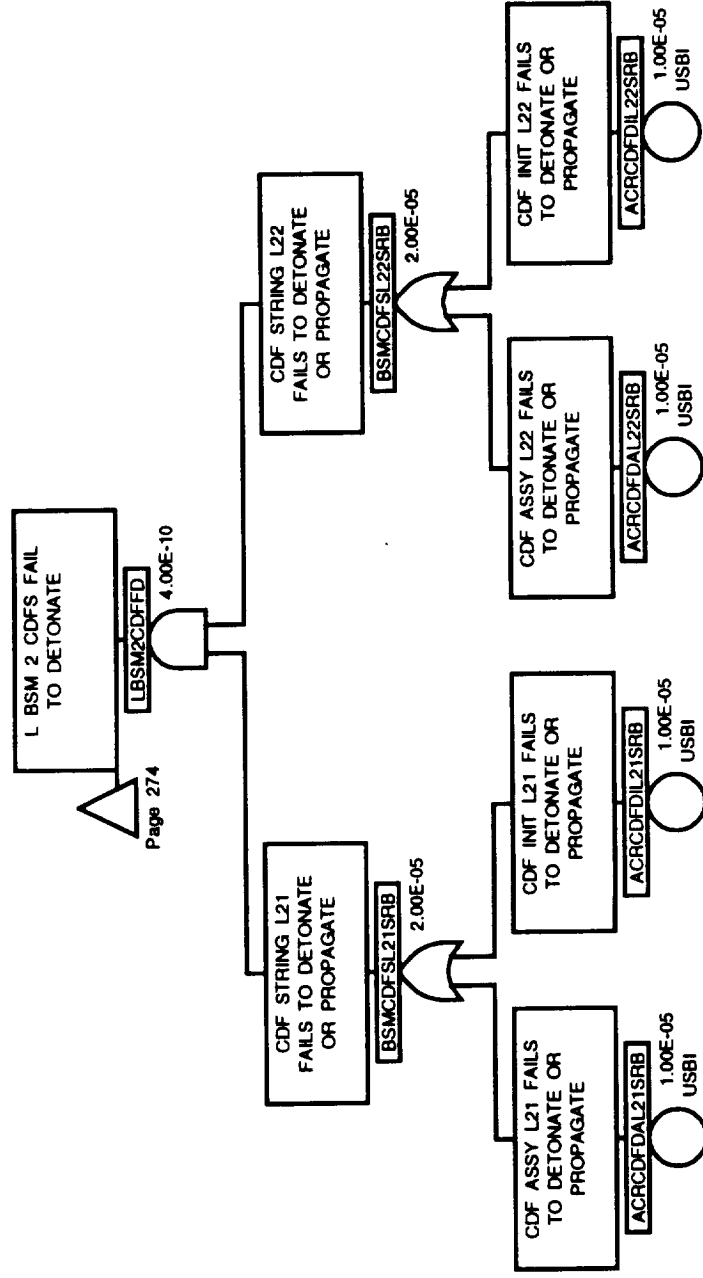


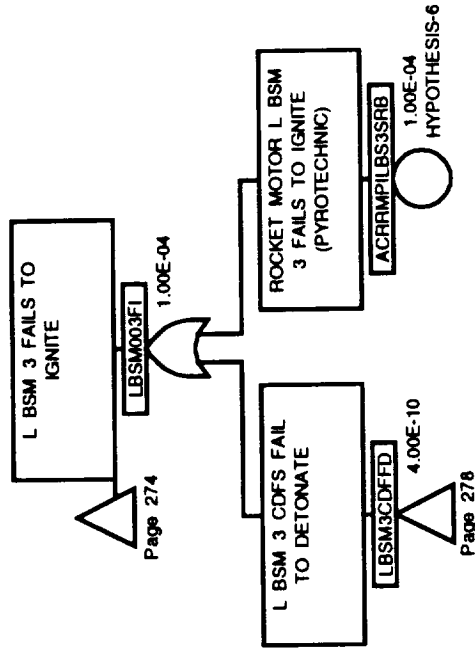


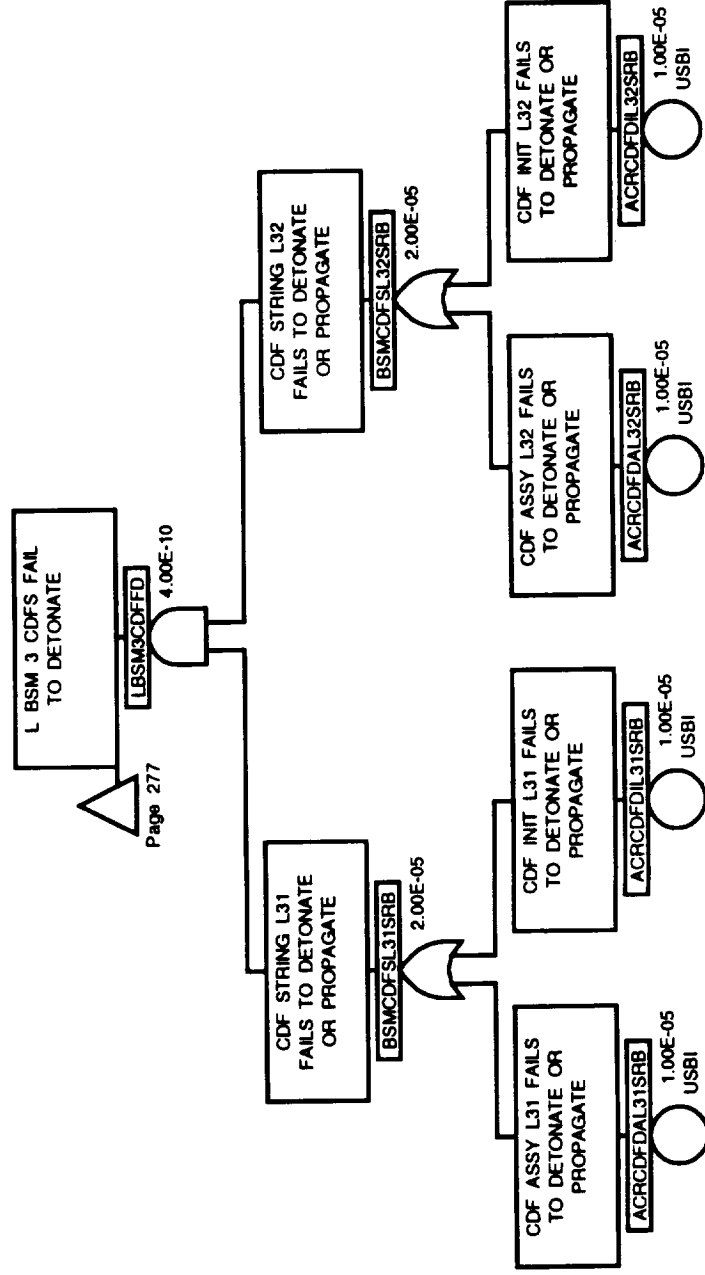




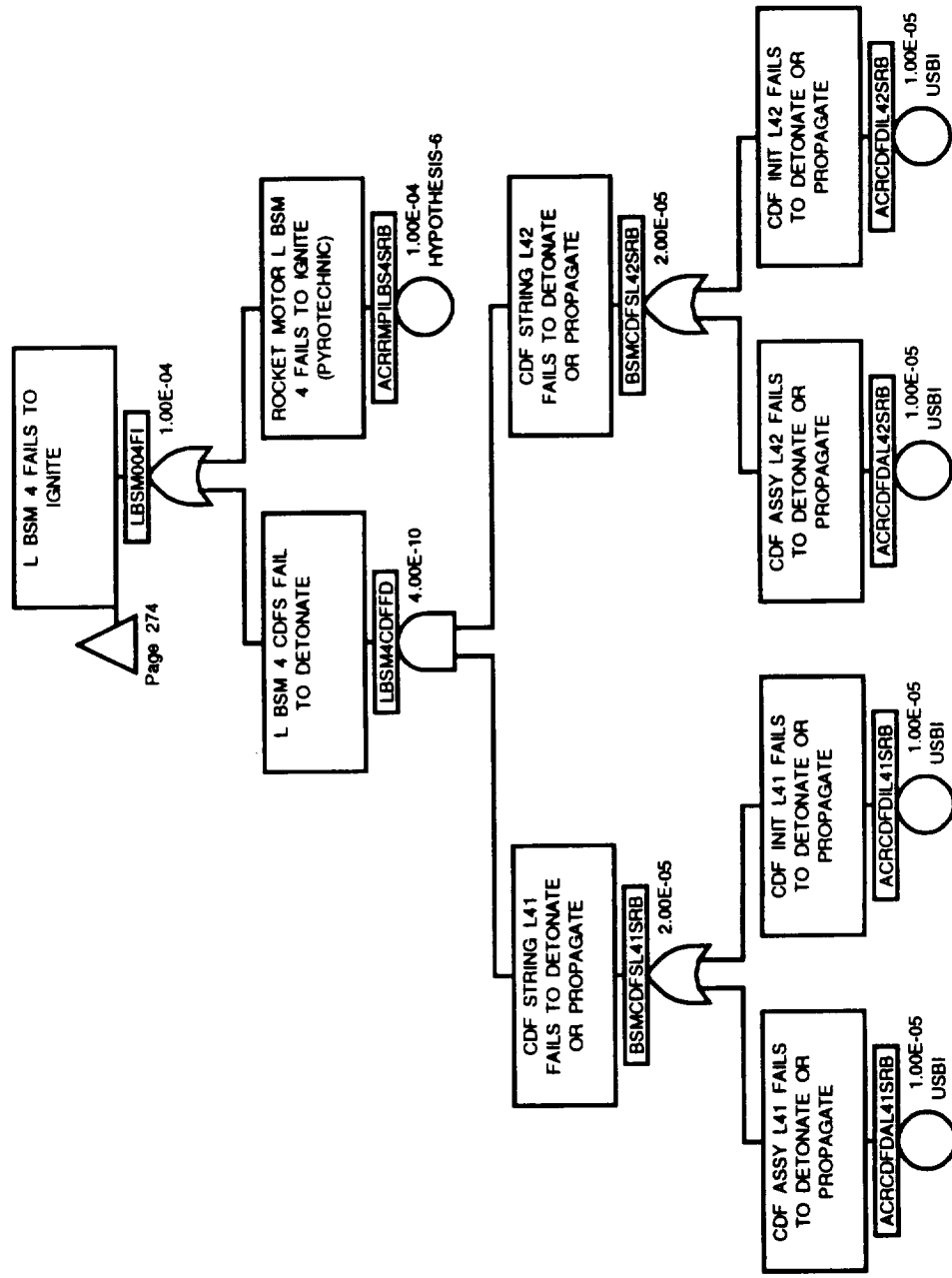
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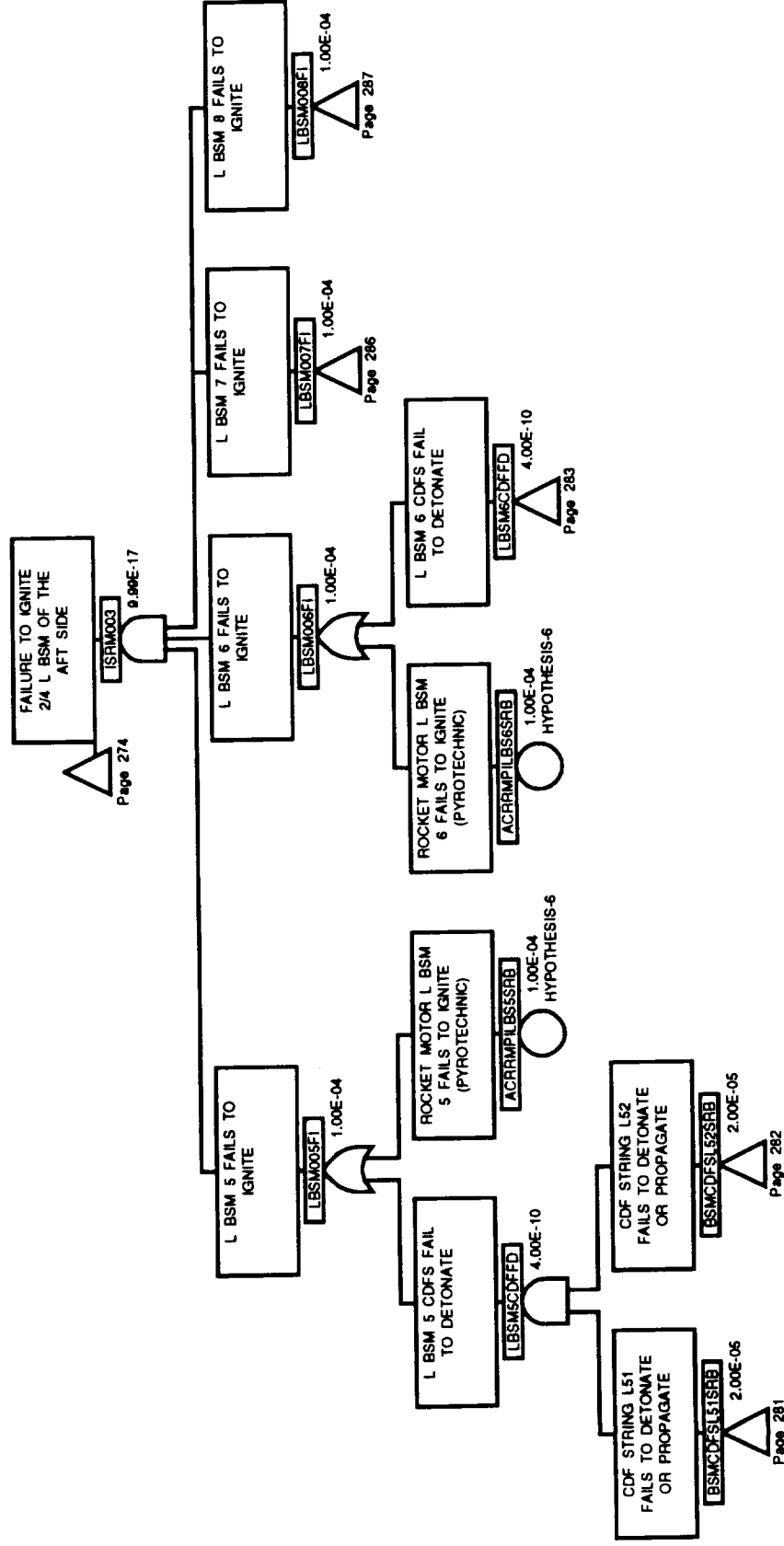


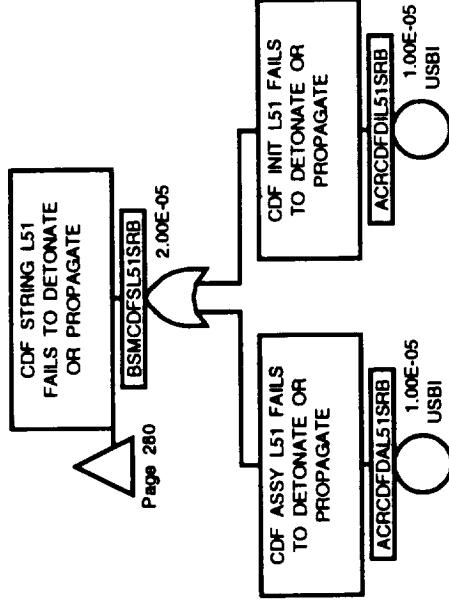


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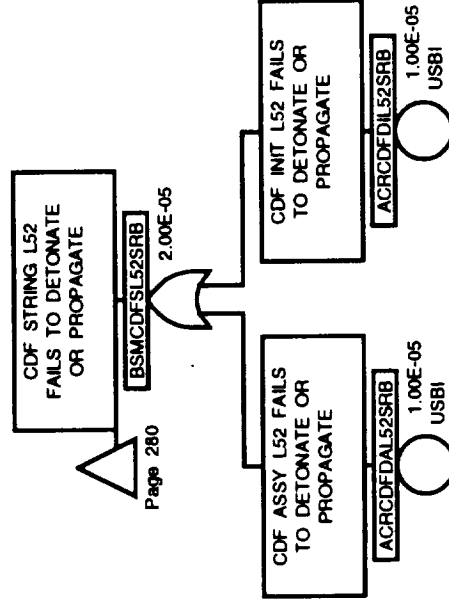


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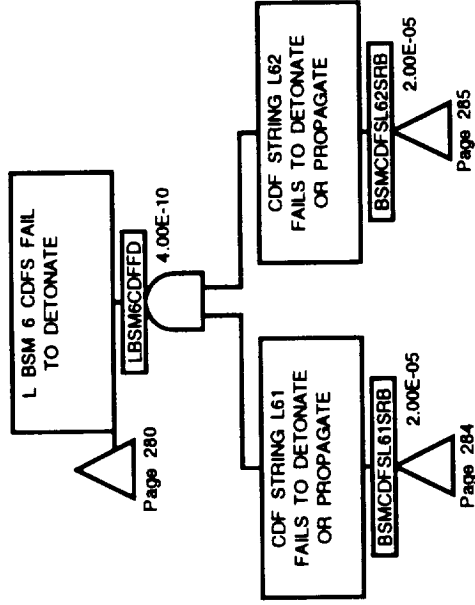


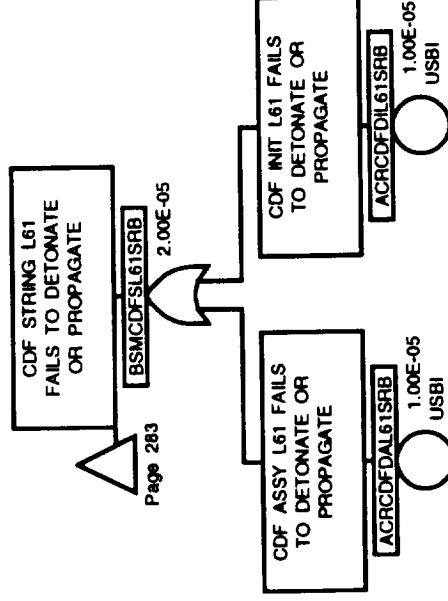


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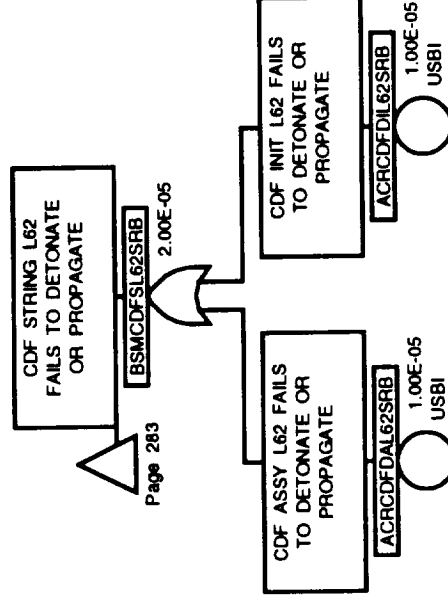


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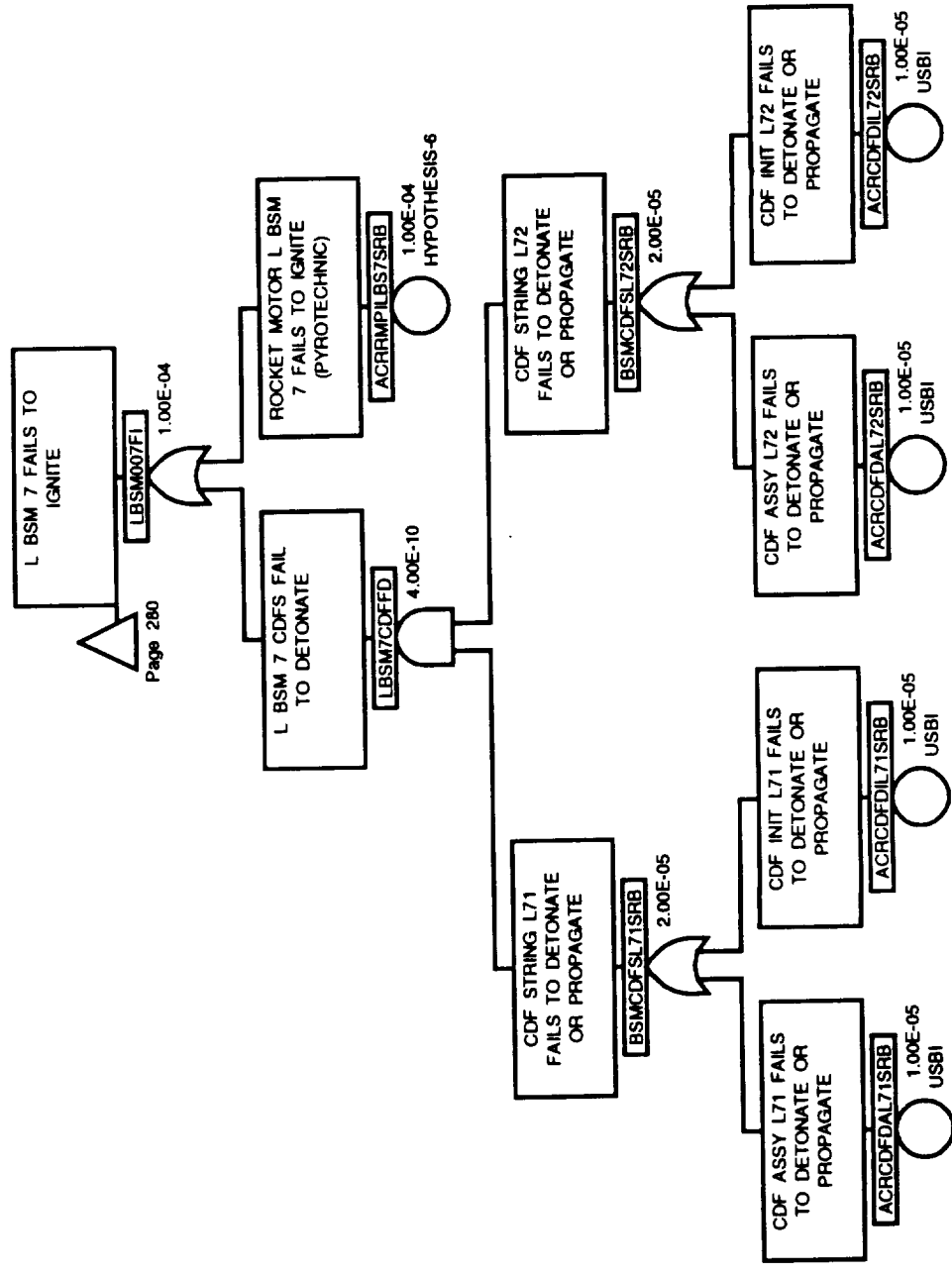




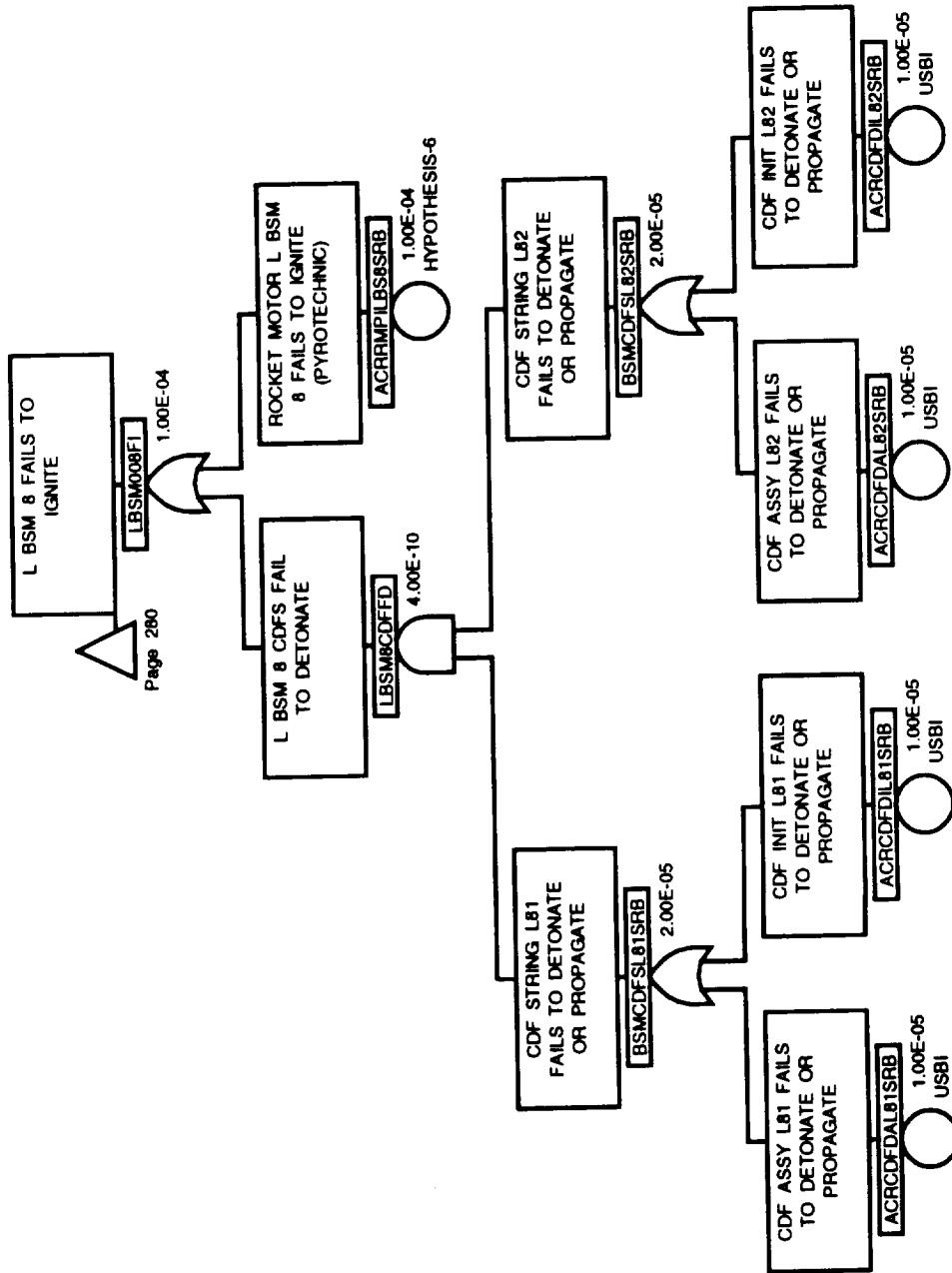
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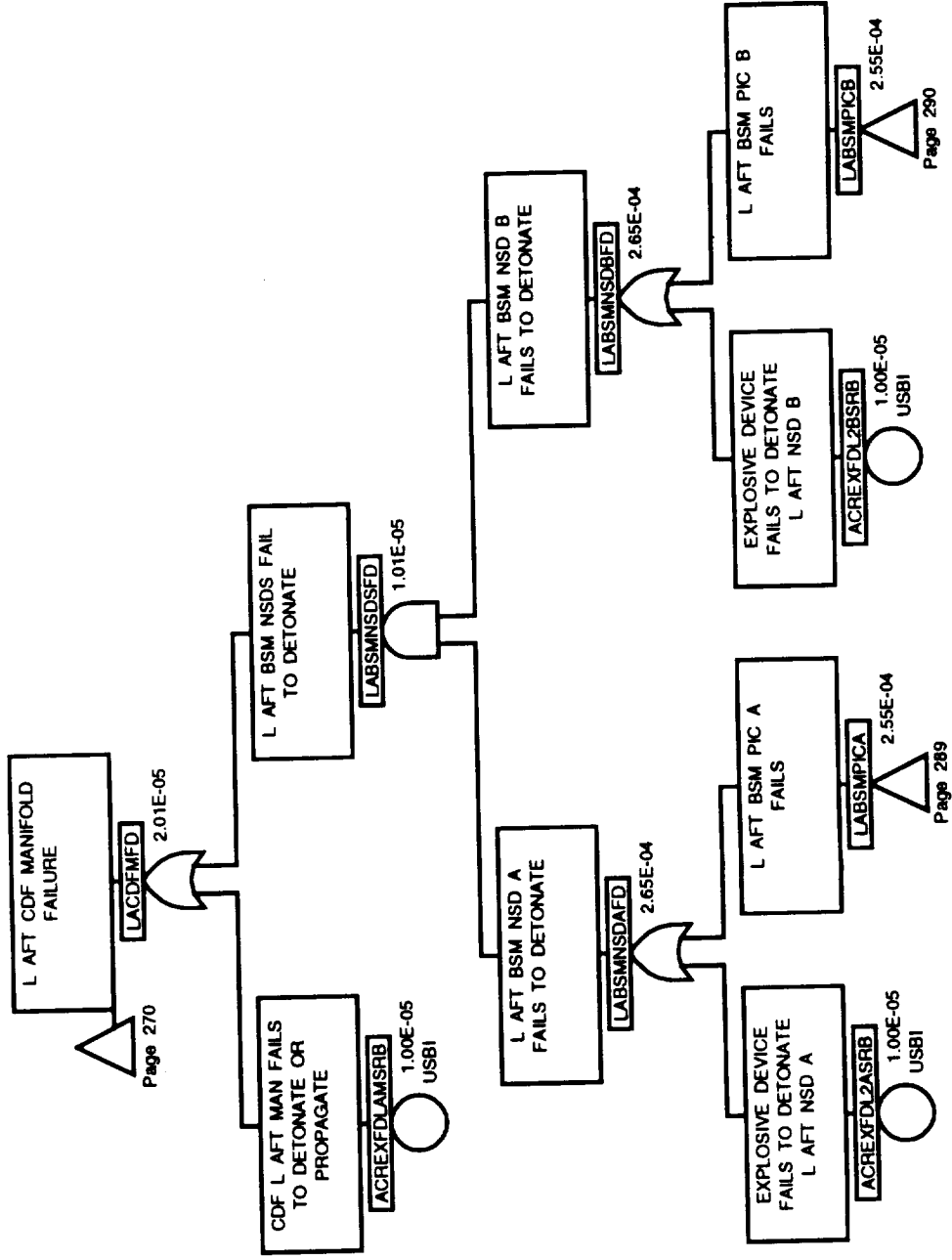


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1.01E-05

2.65E-04

2.65E-04

1.00E-05 USBI

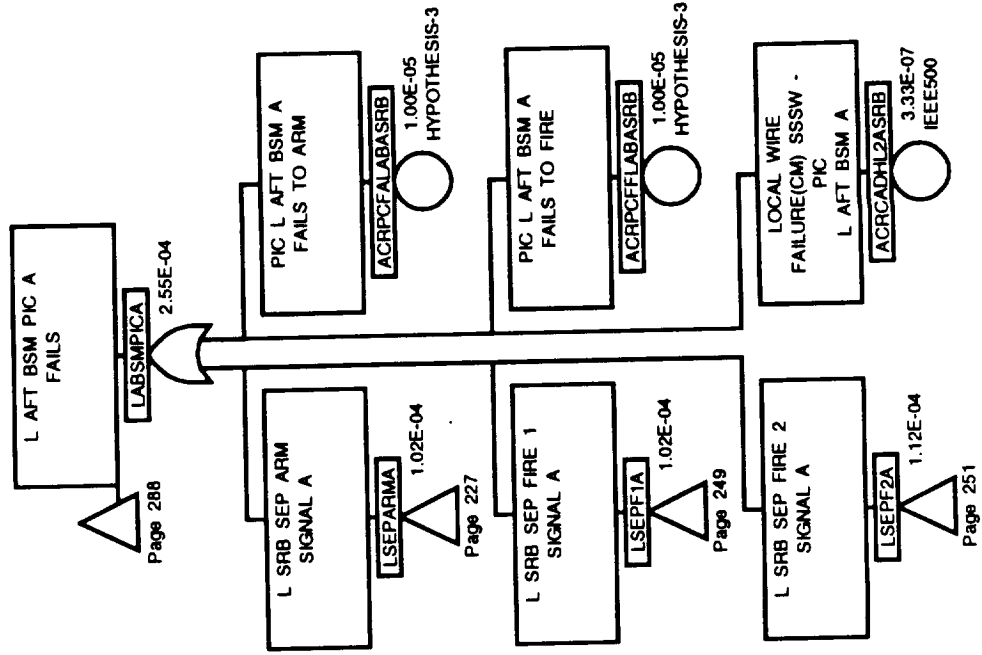
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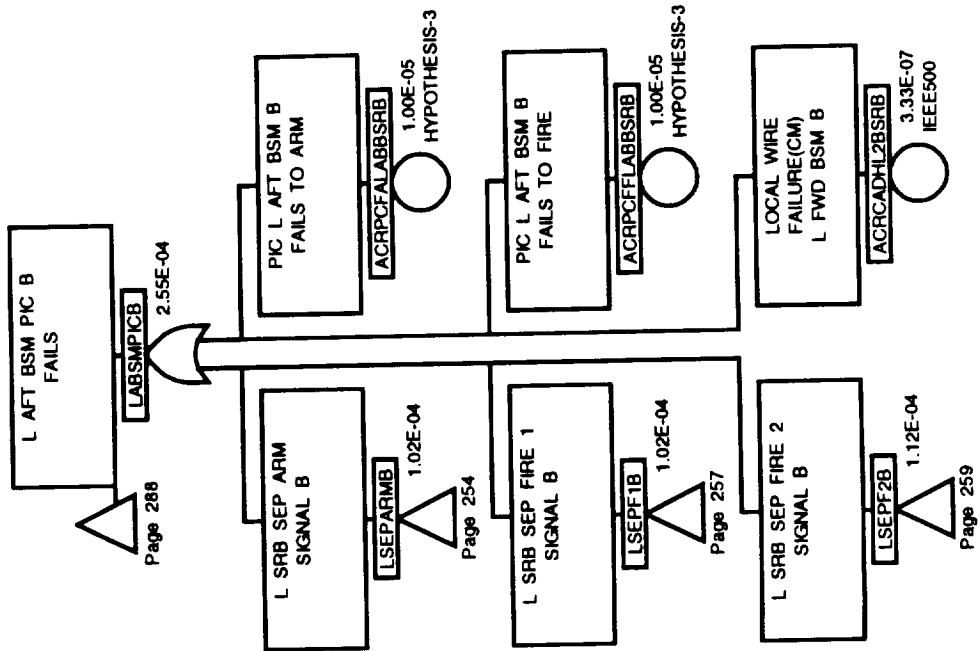
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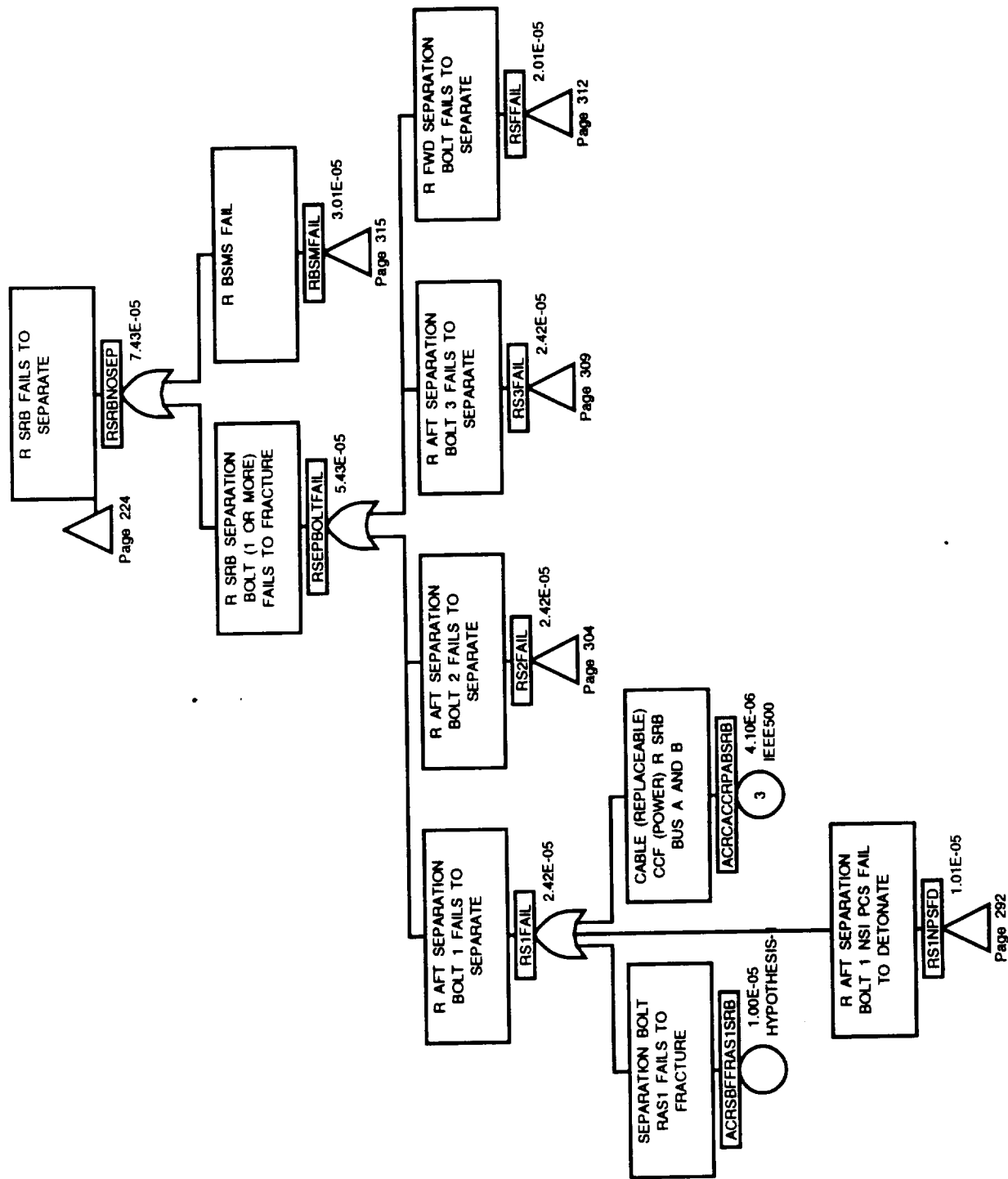
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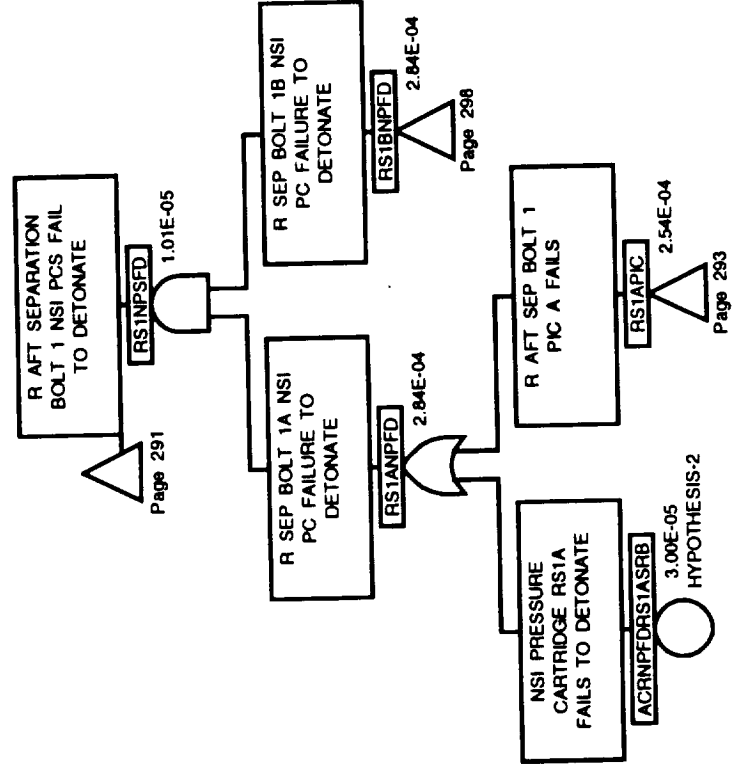
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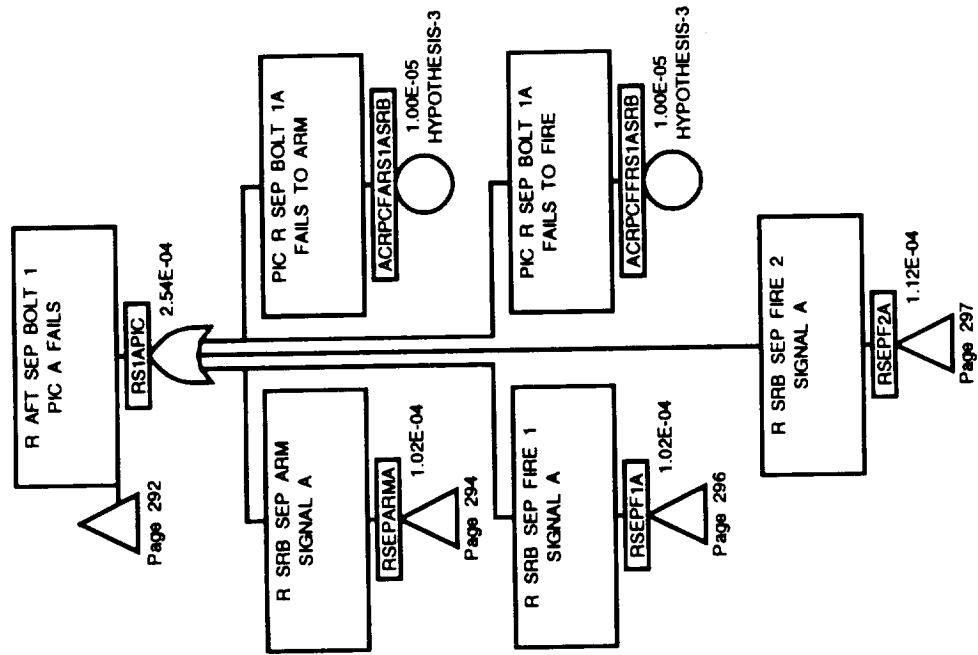
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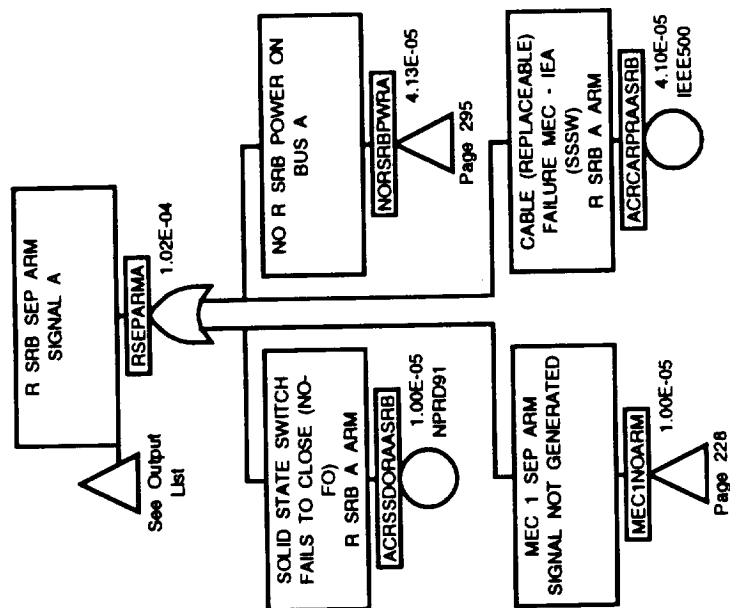


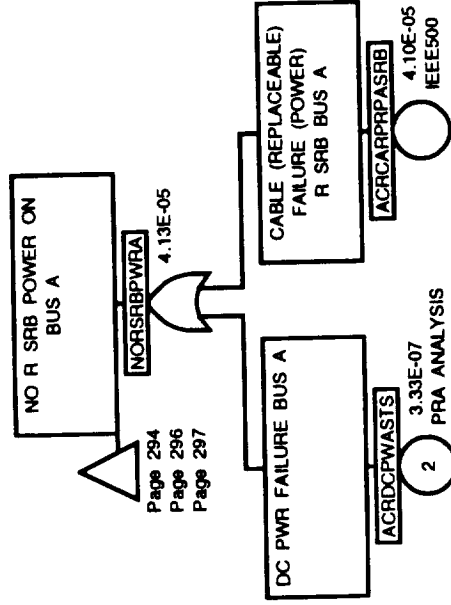




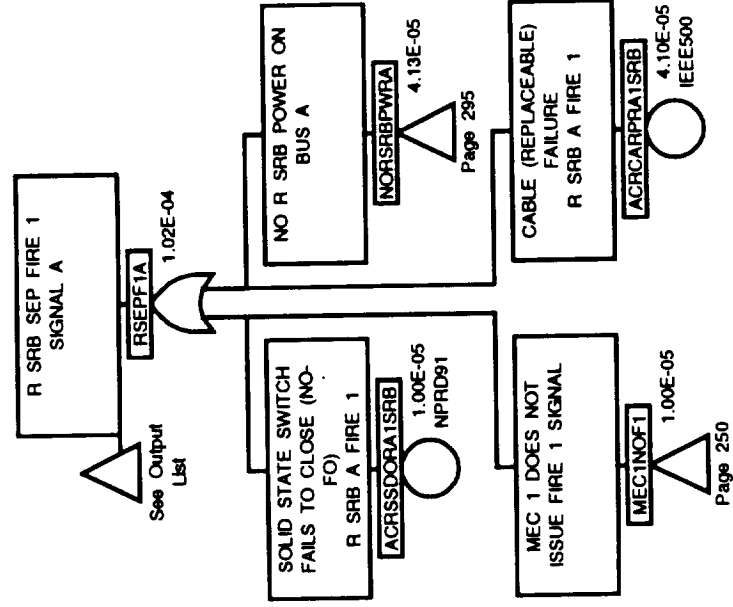


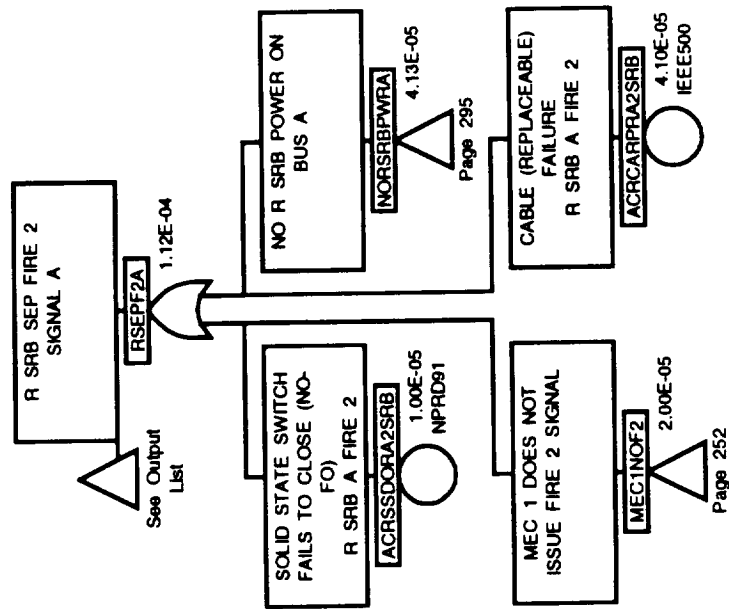


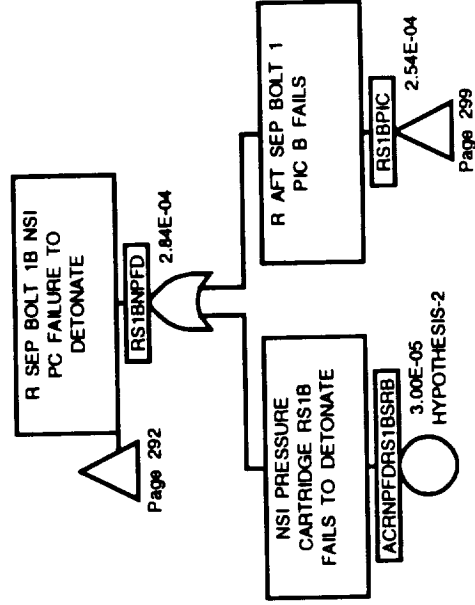


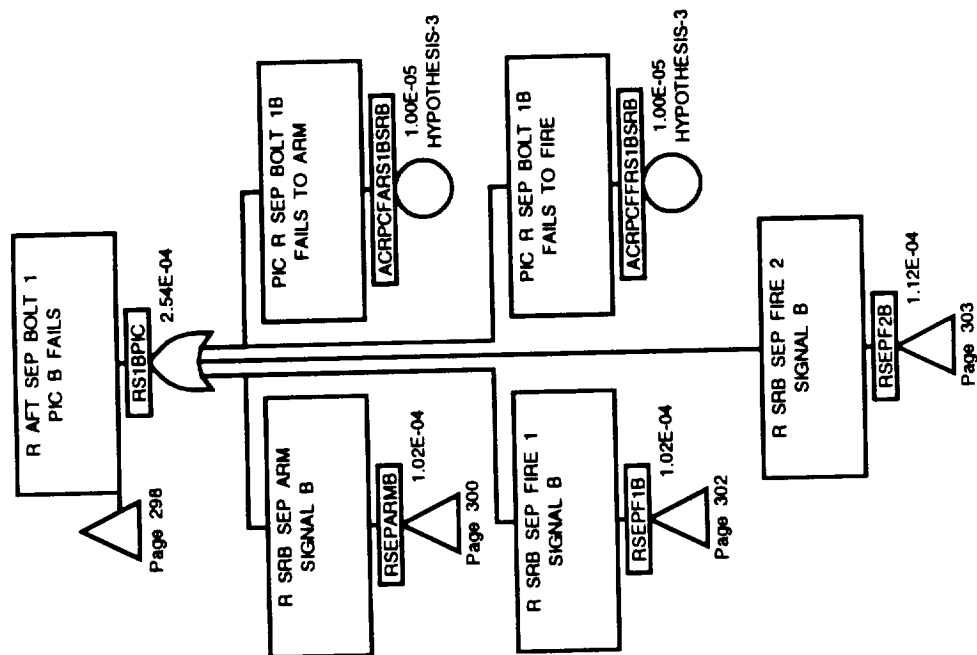


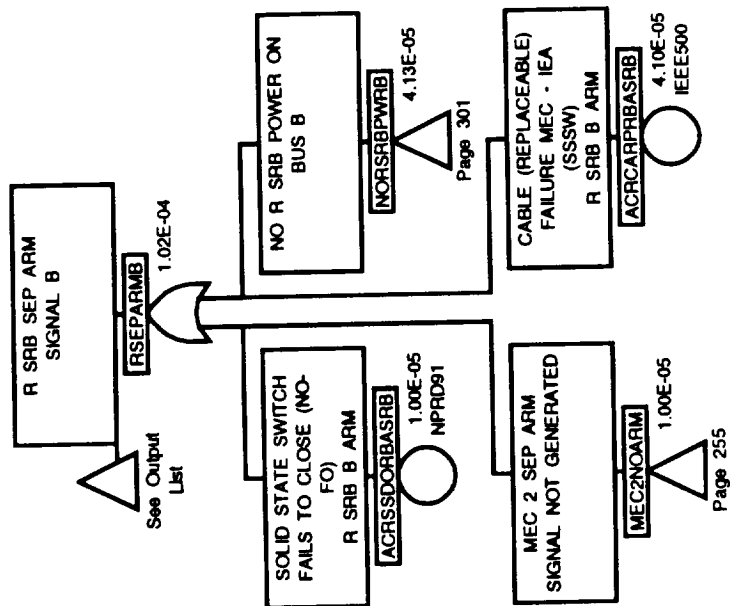
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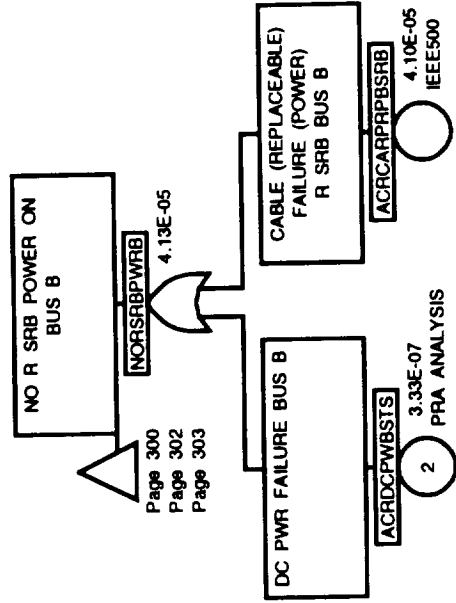




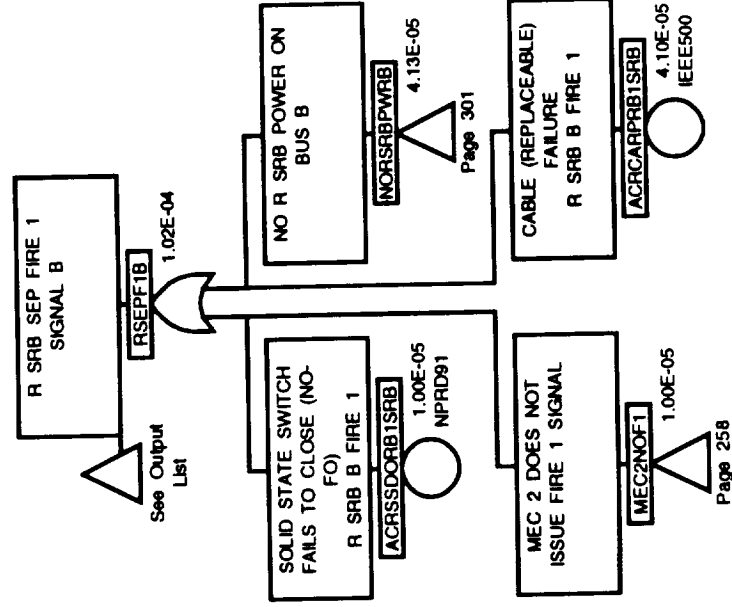


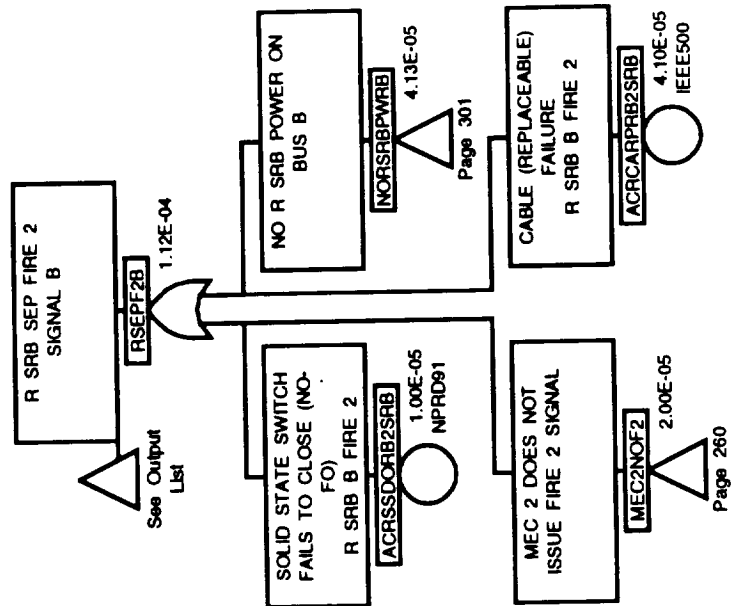


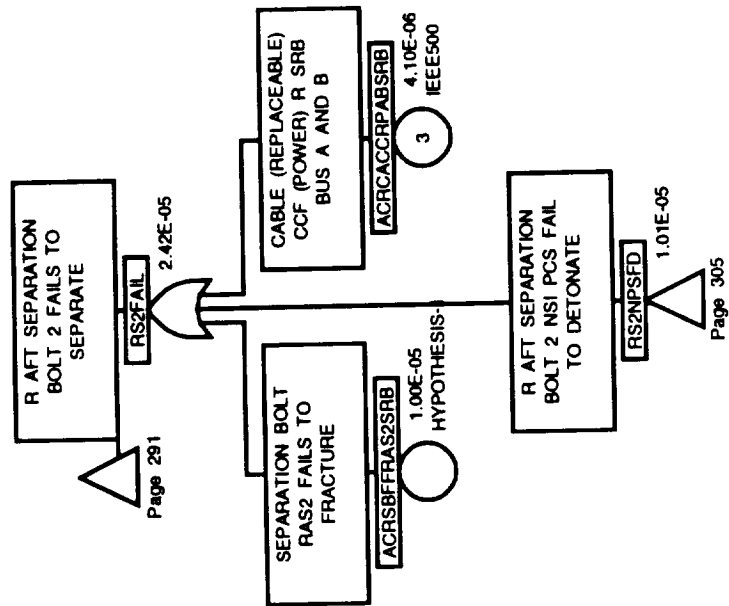


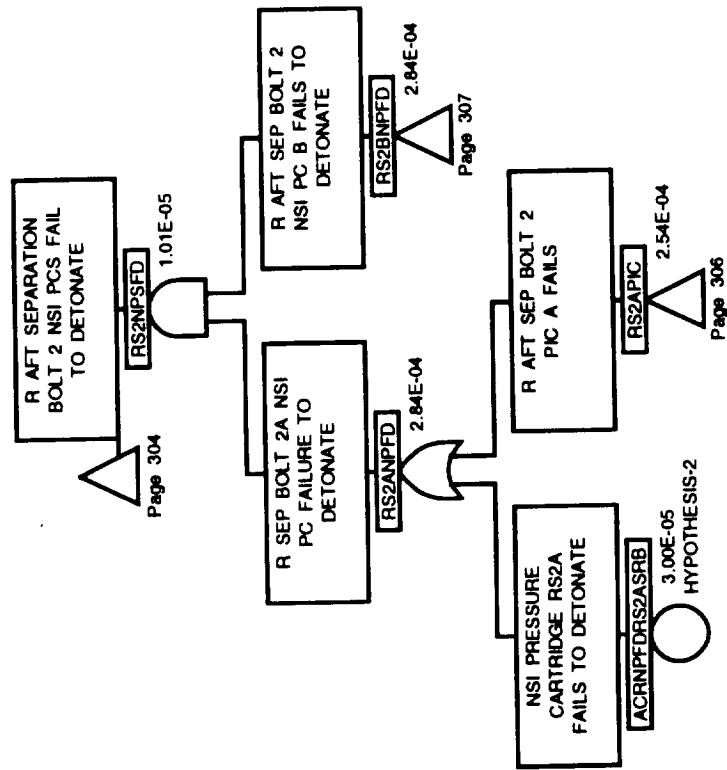


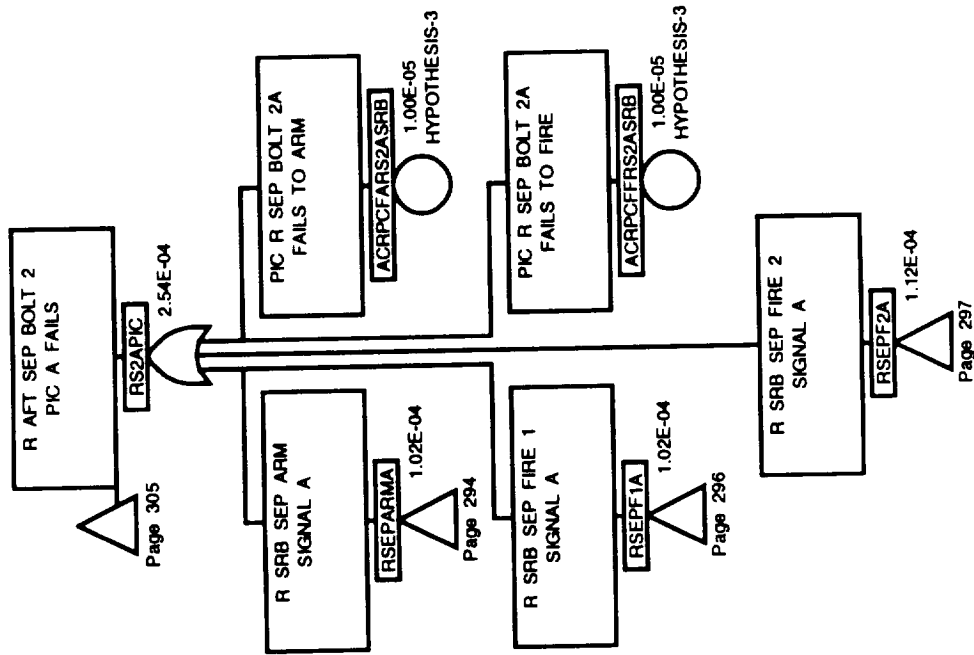
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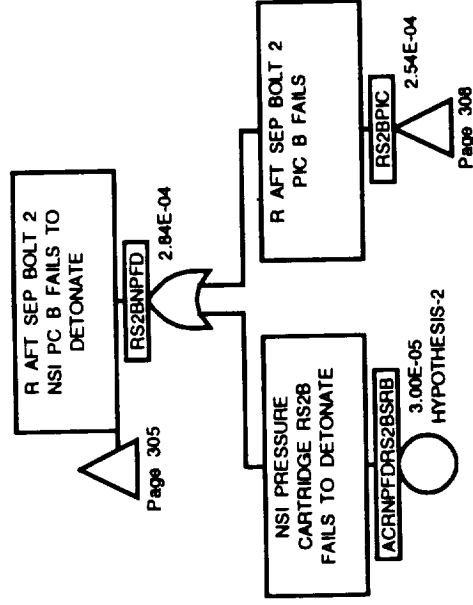


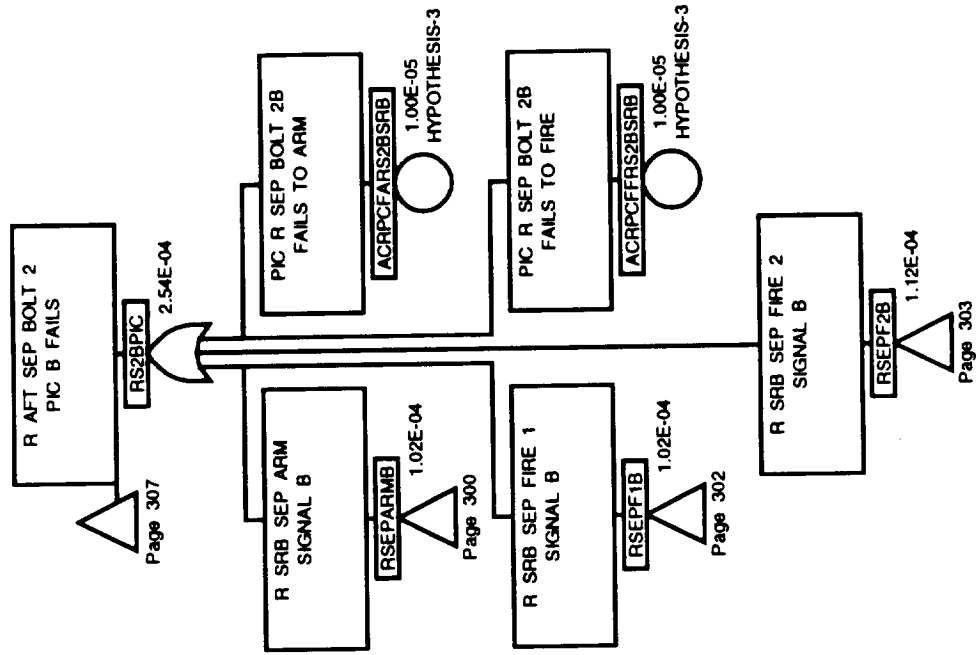


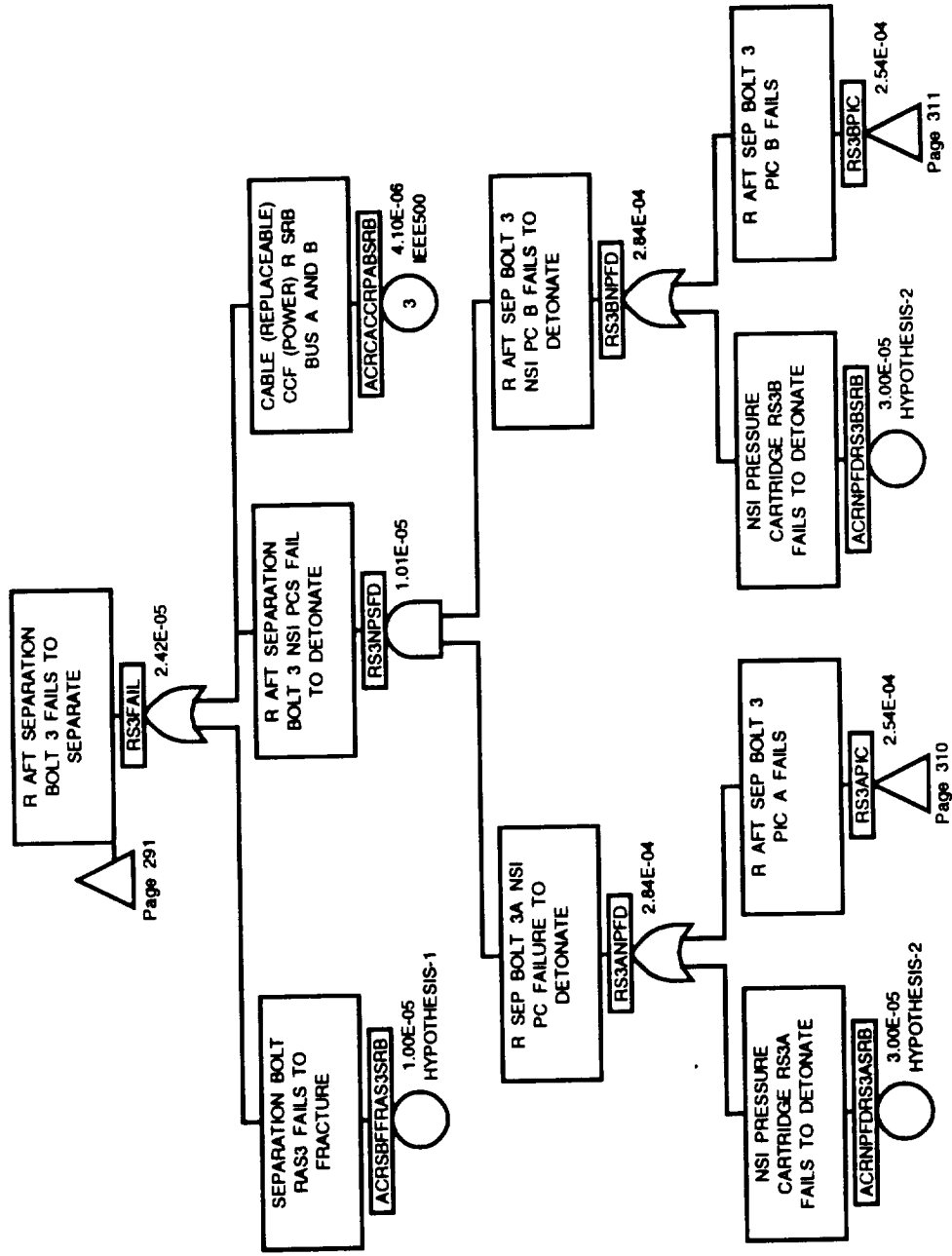








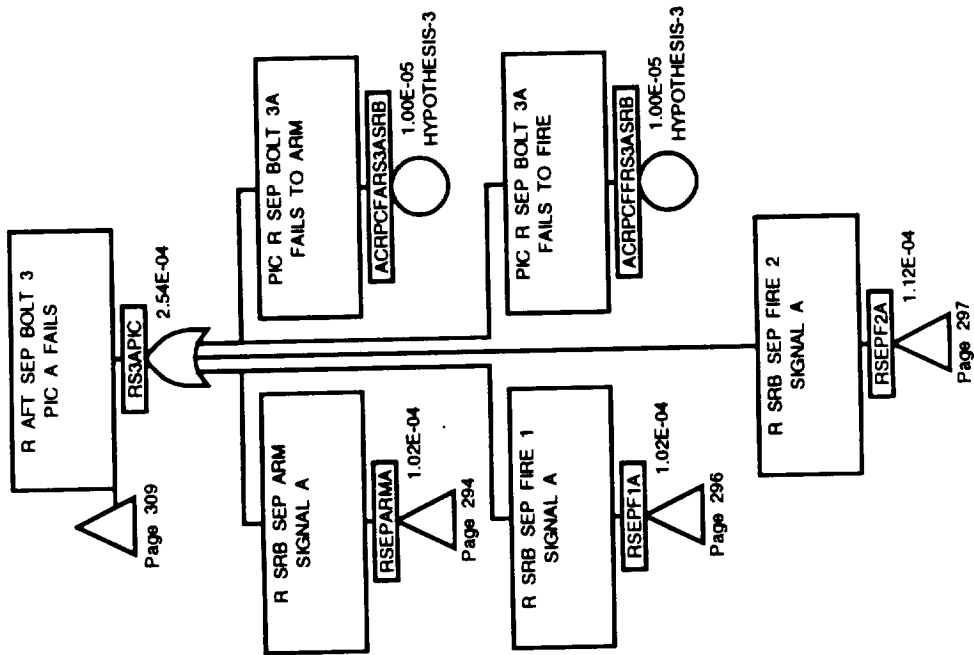


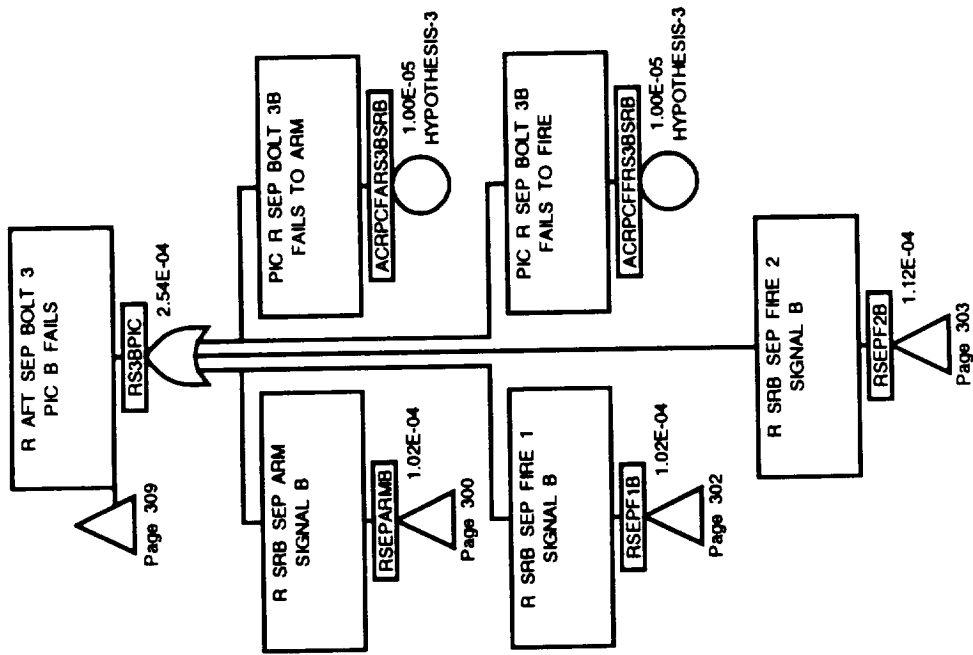


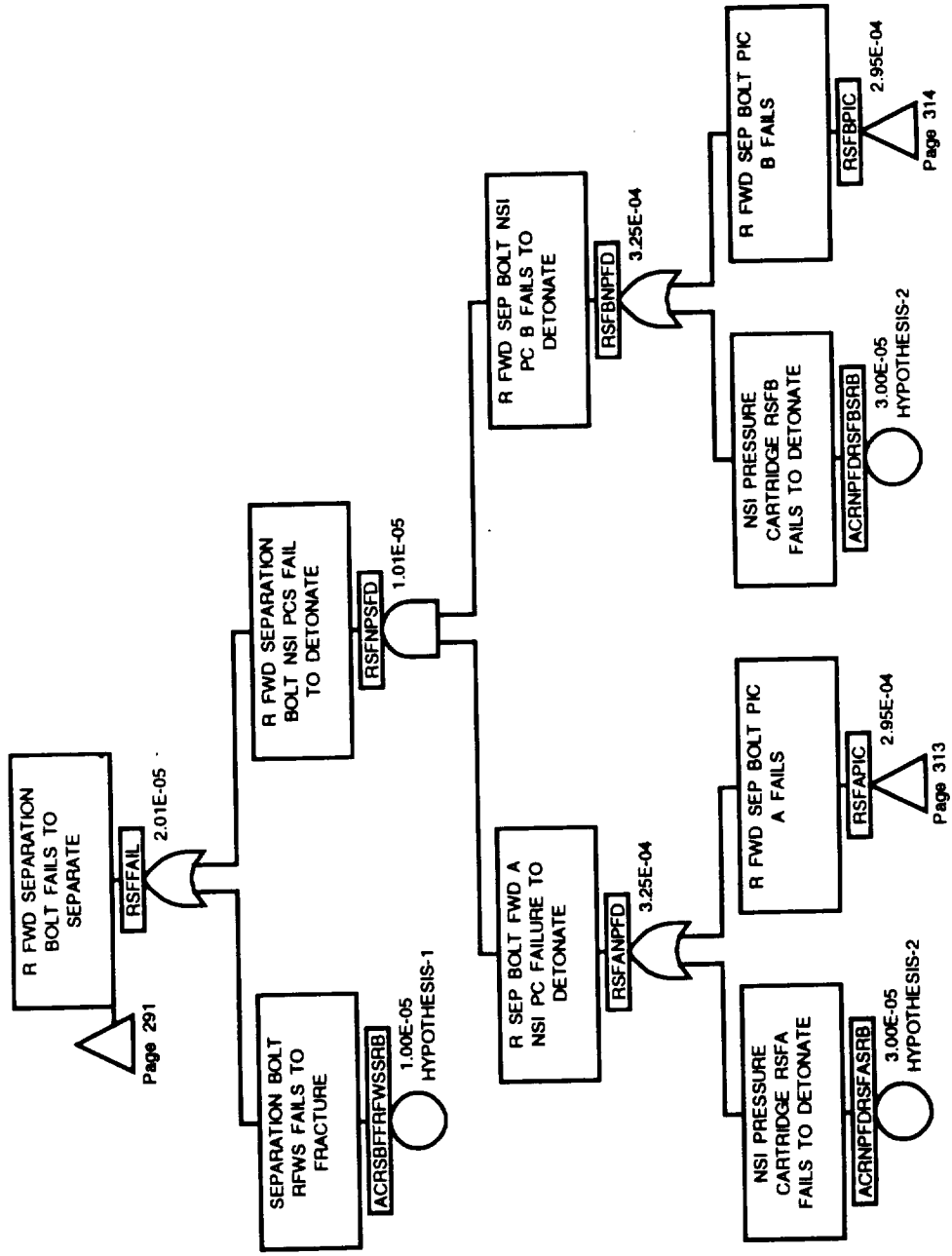
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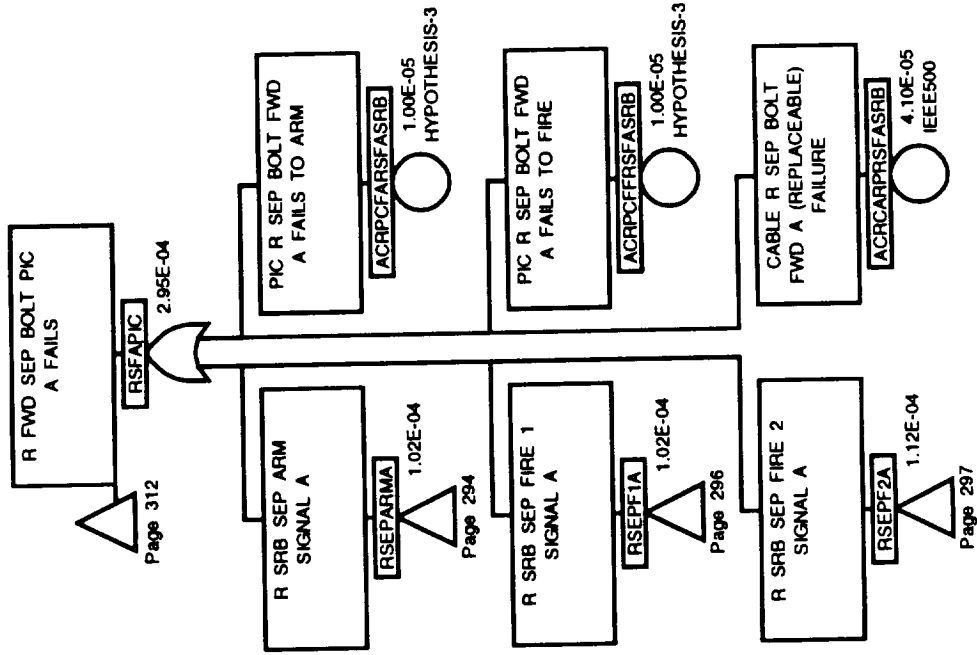
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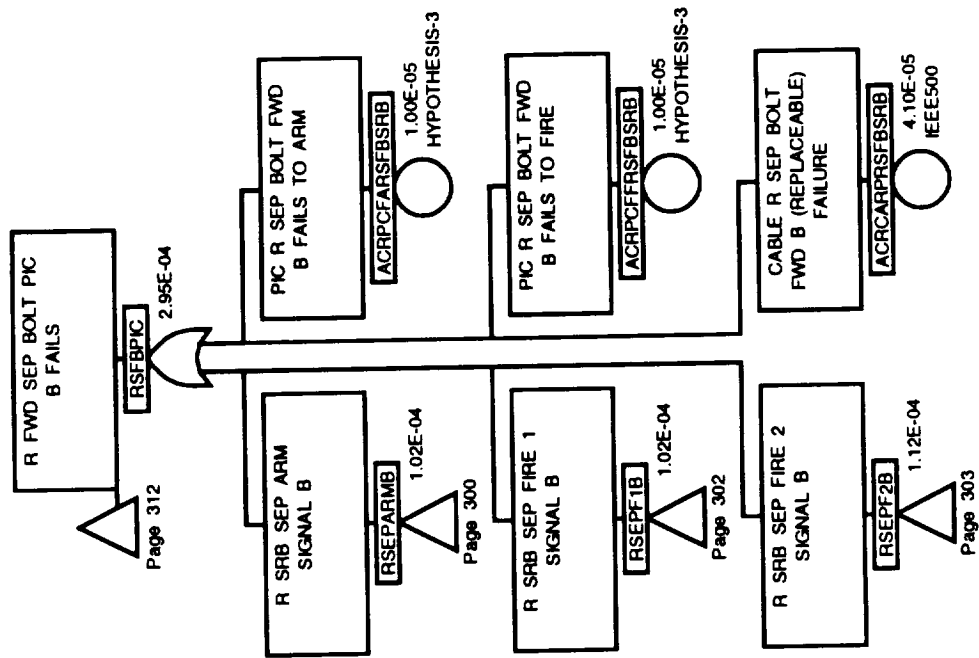
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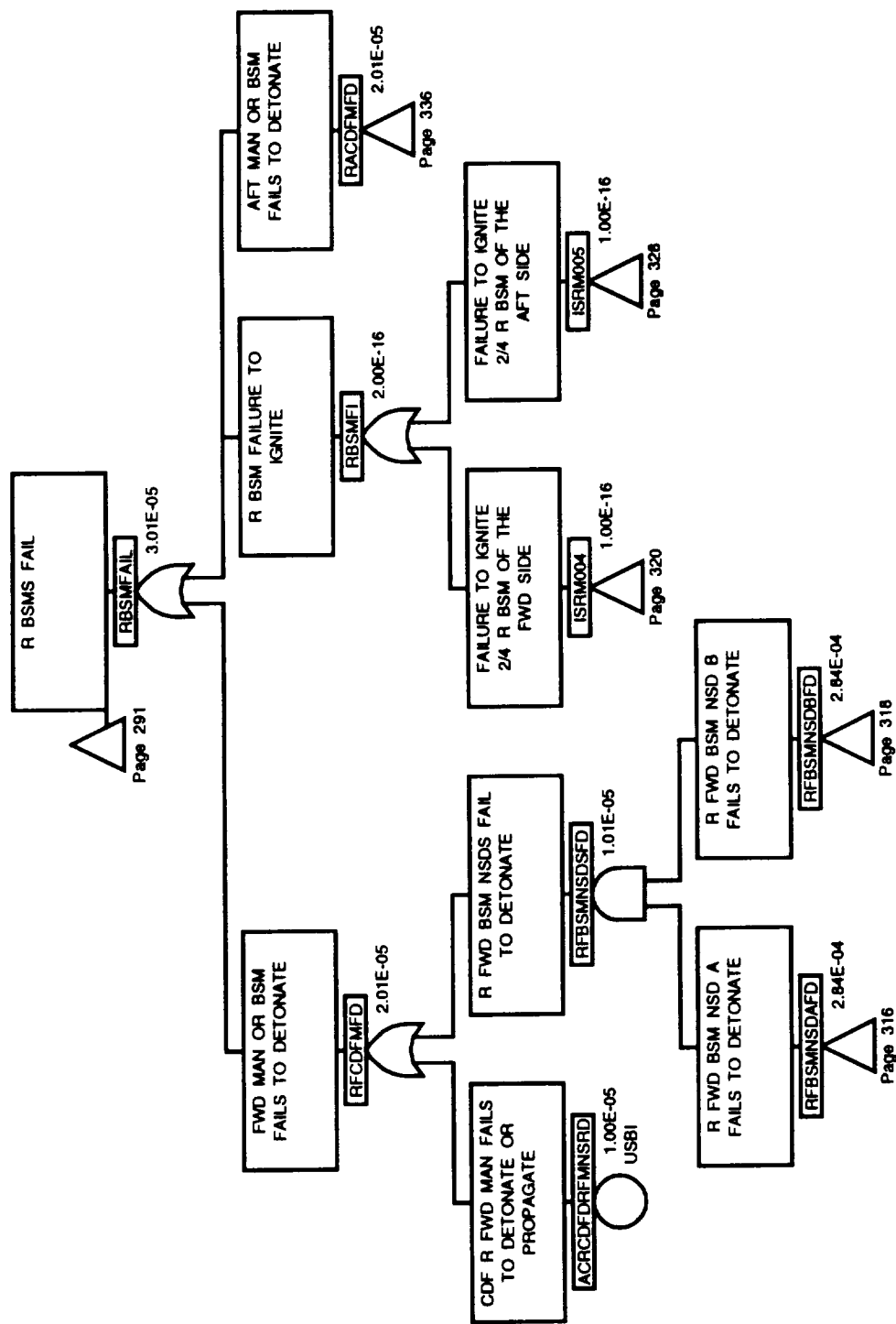


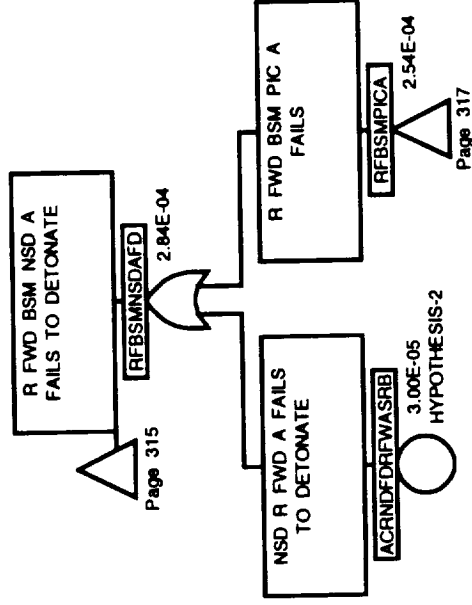


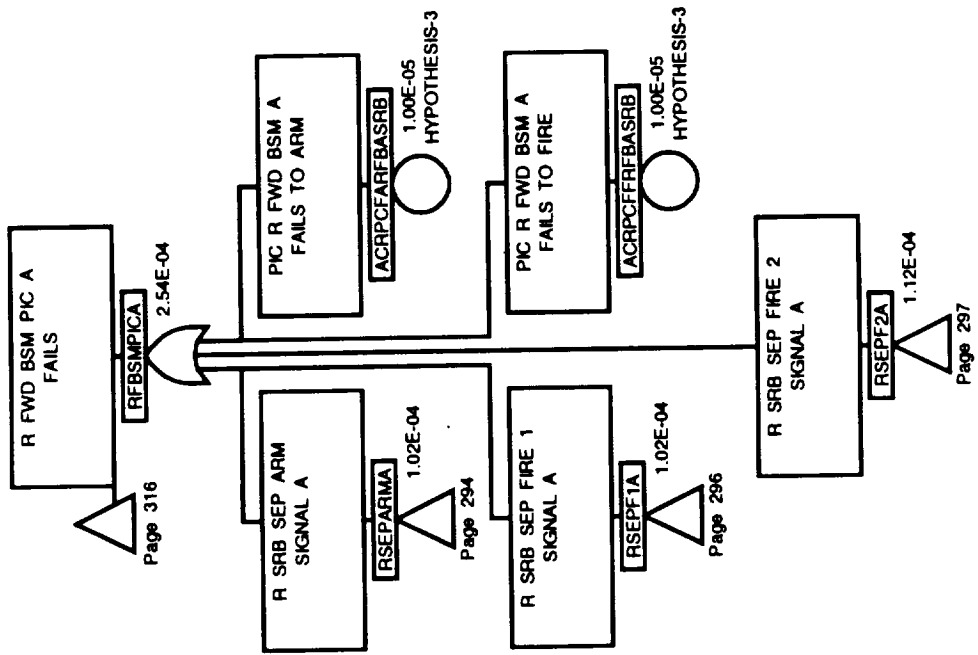


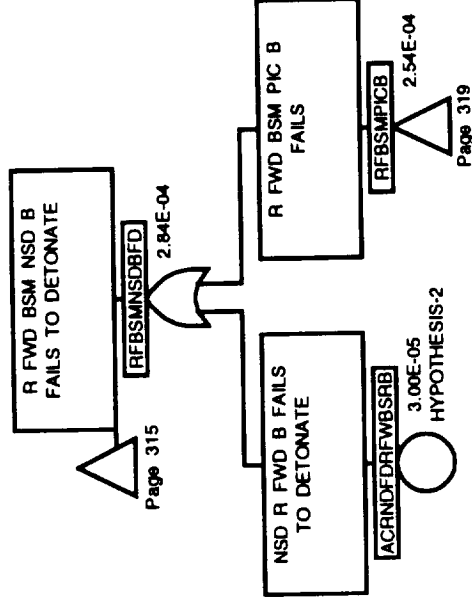


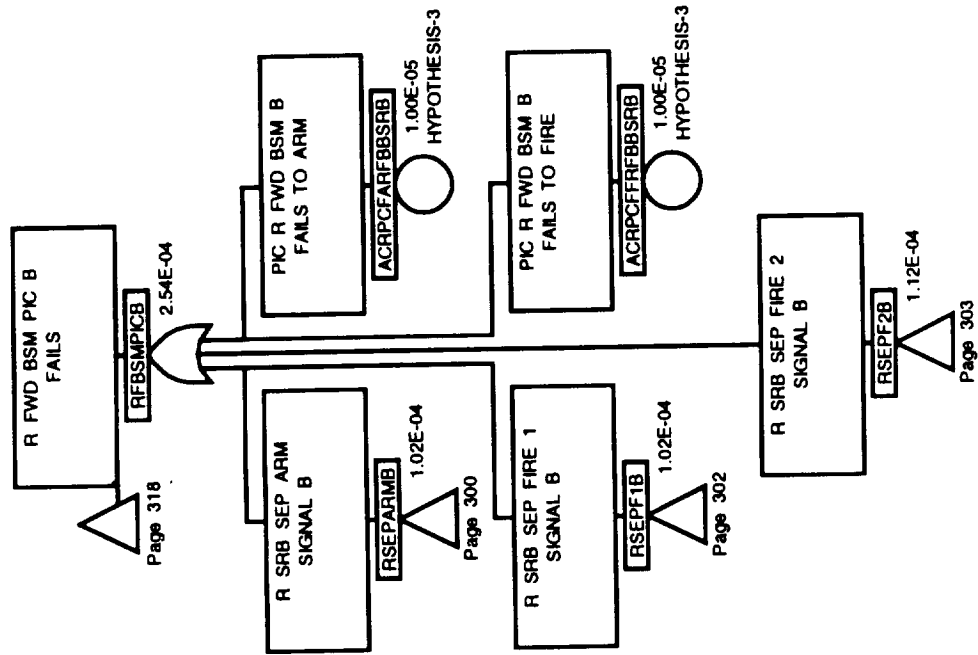


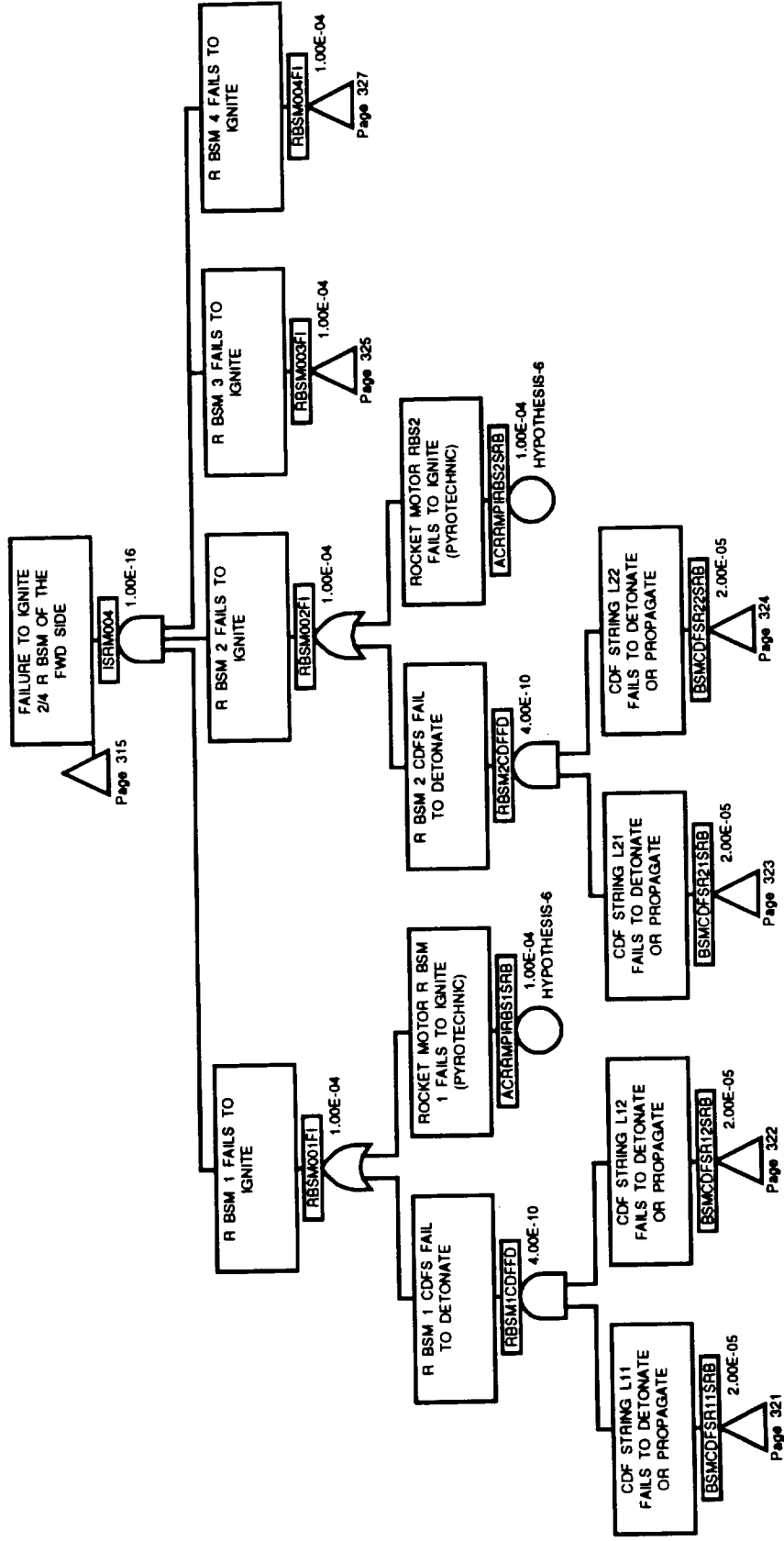


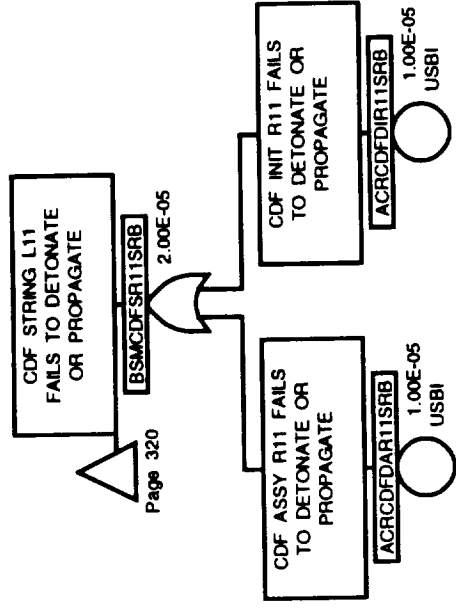


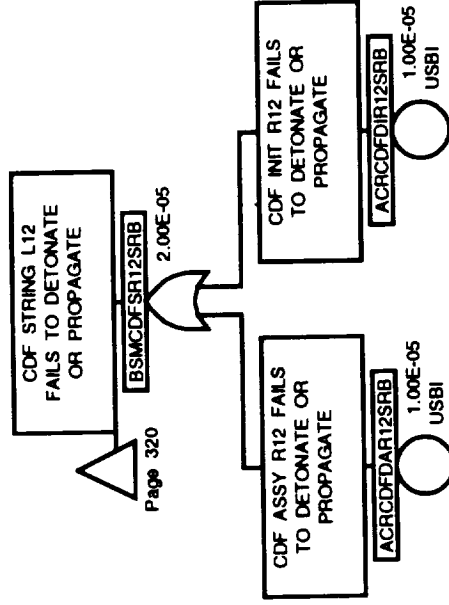




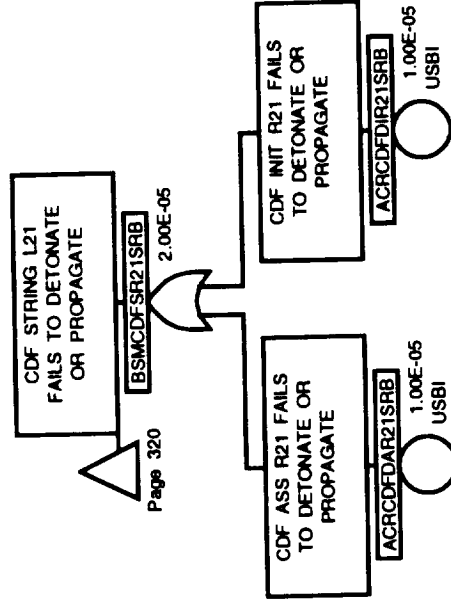




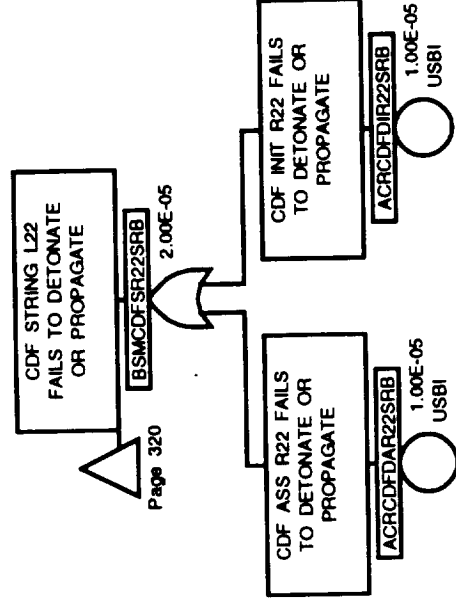




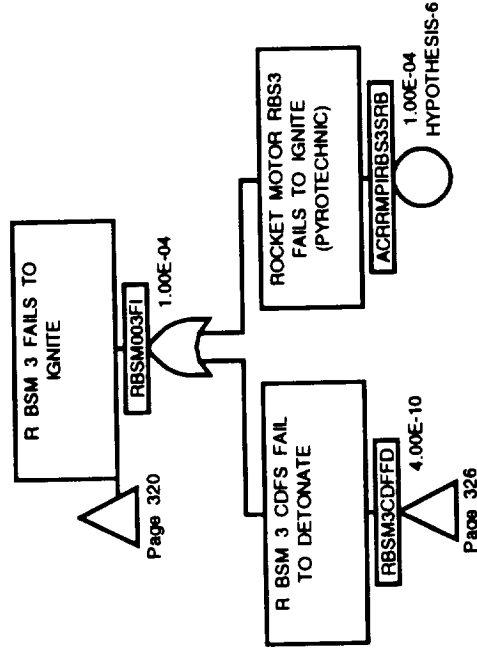
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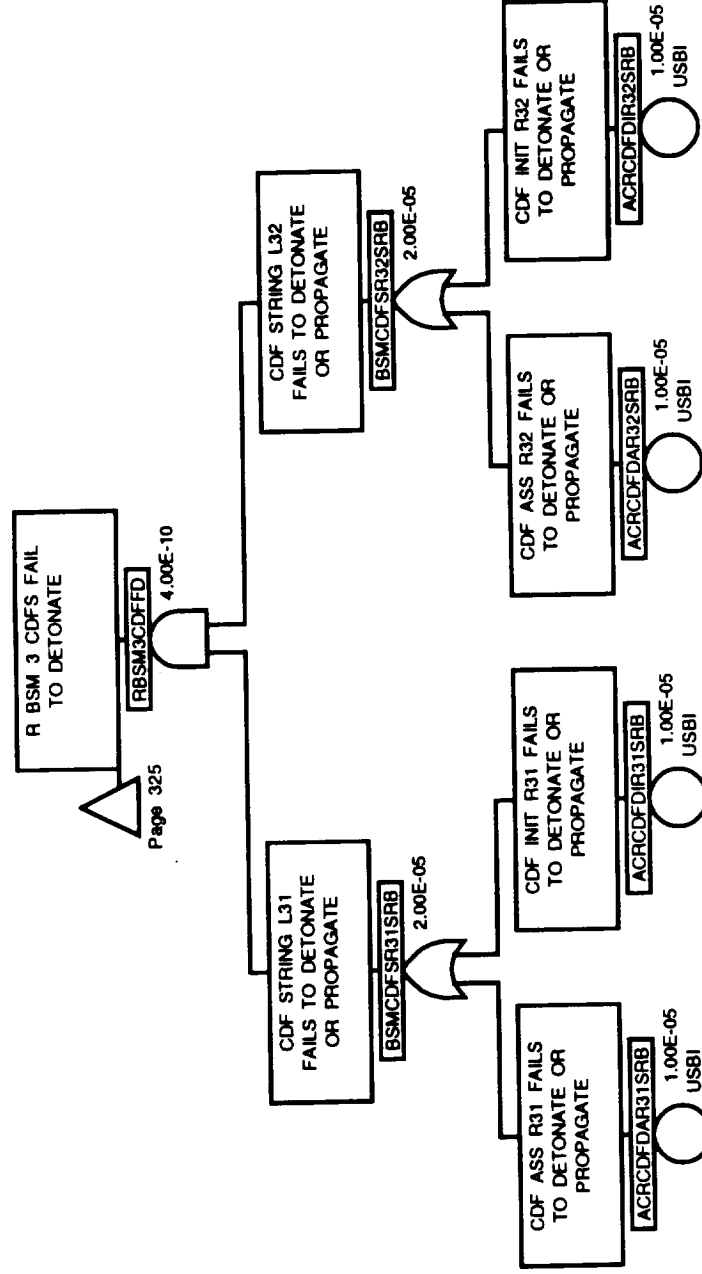


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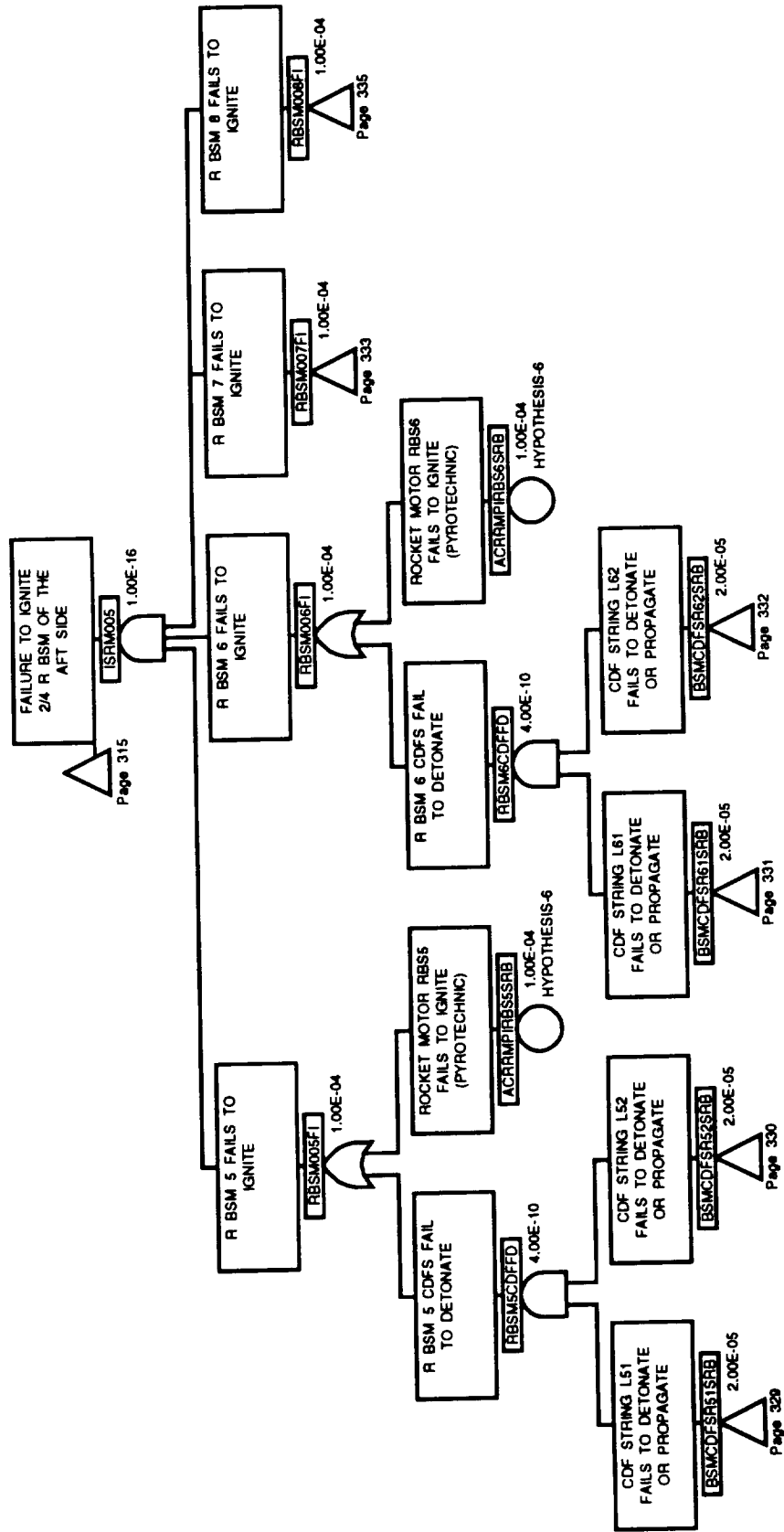


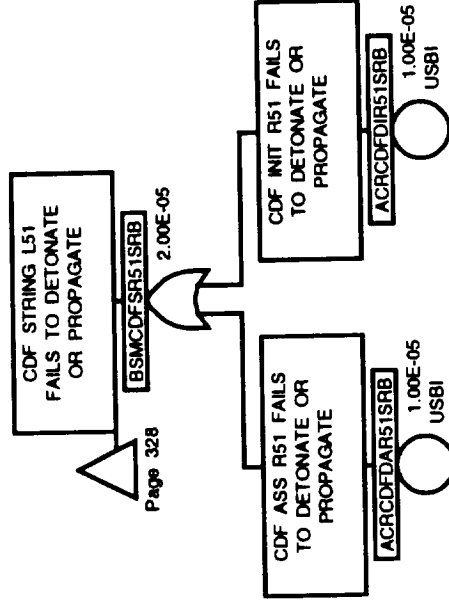
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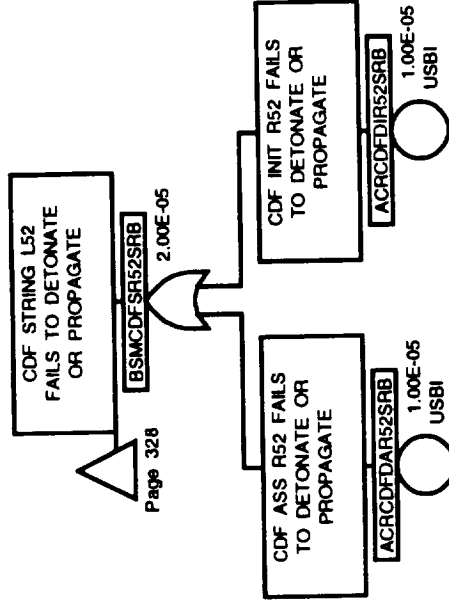


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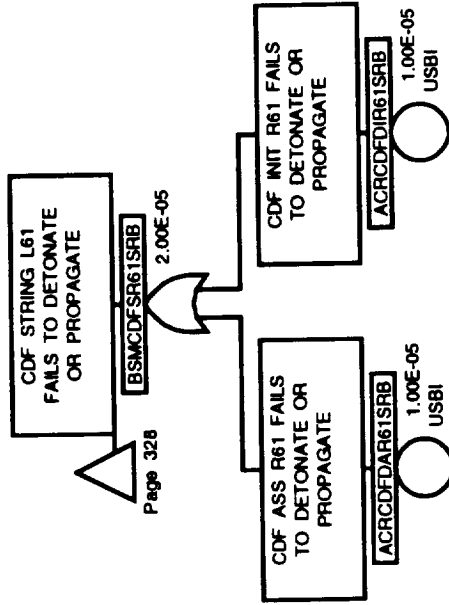




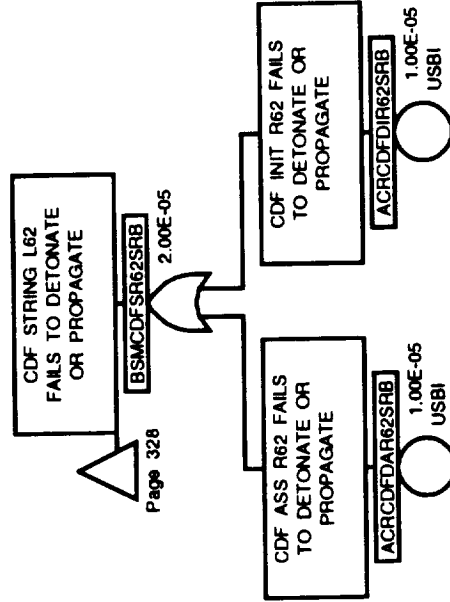
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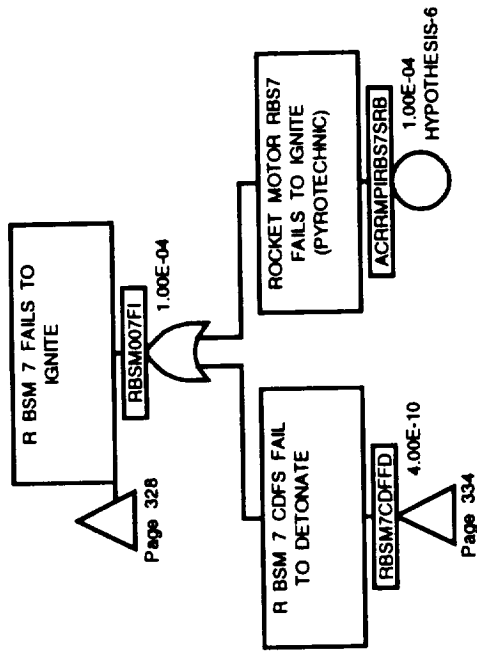
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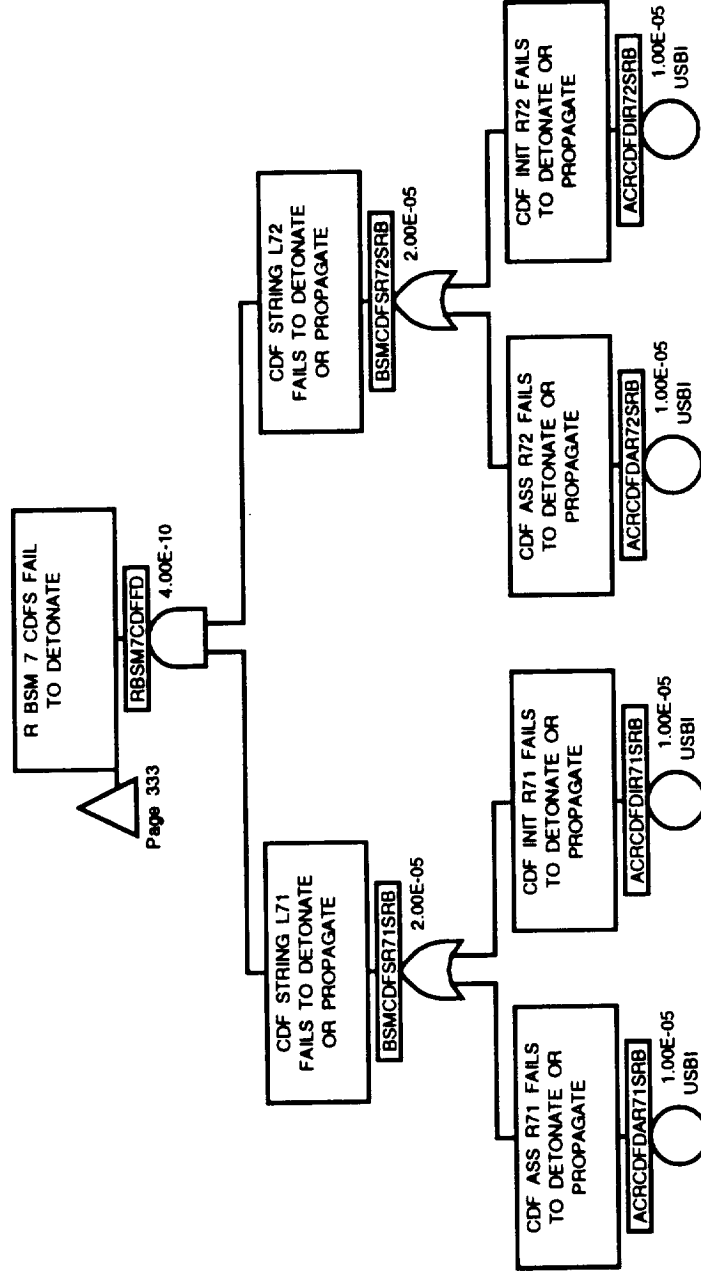


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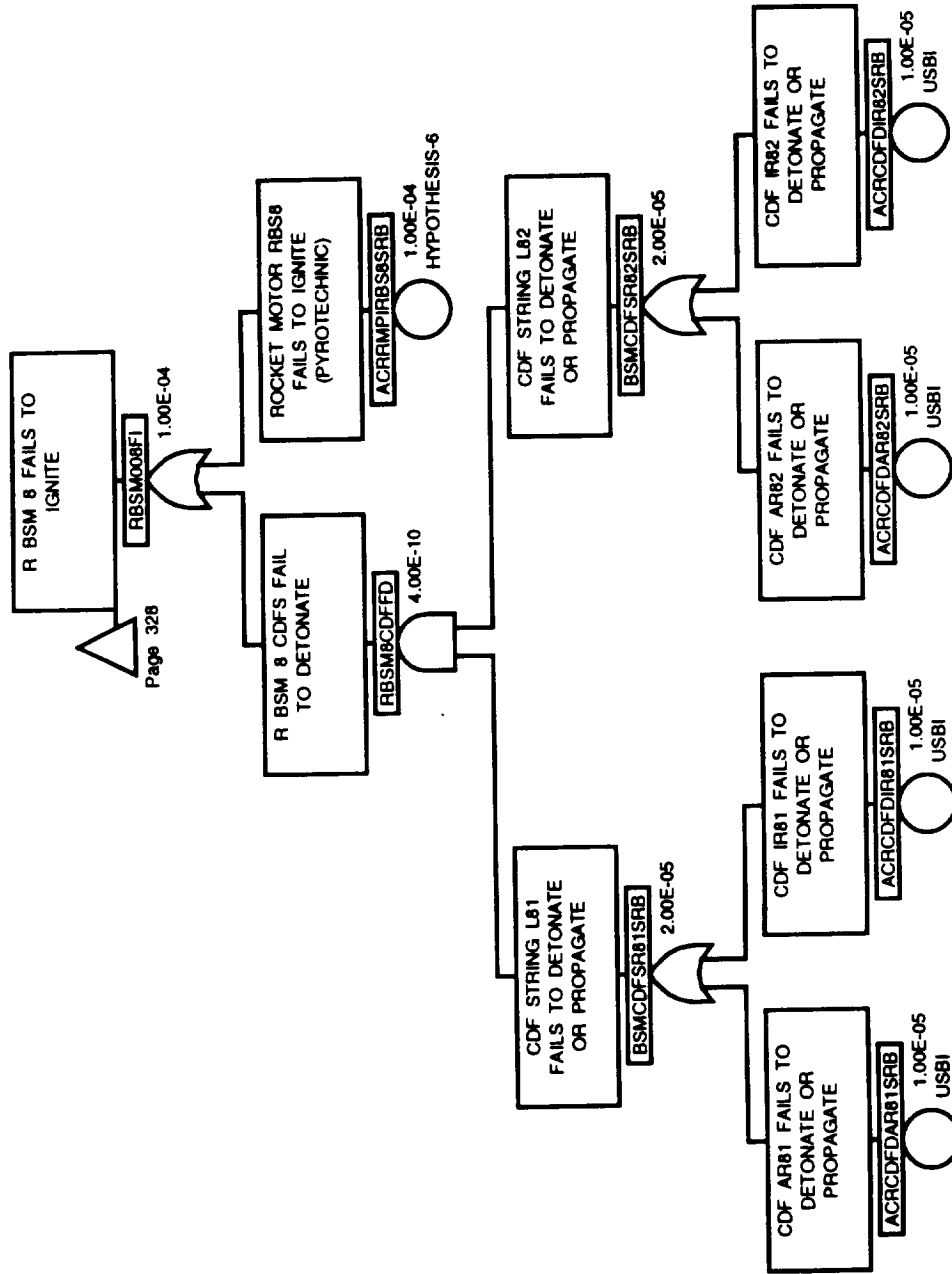


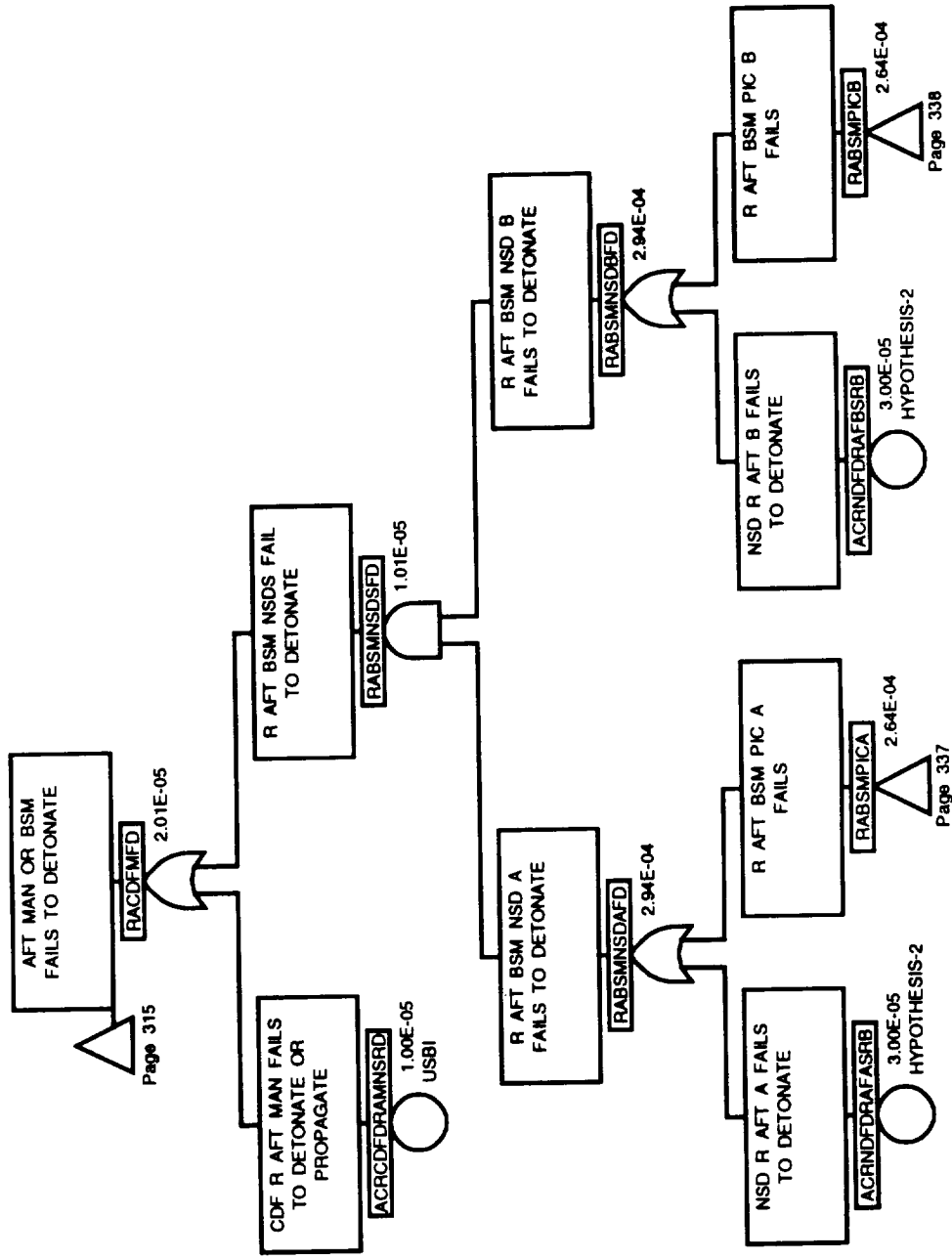
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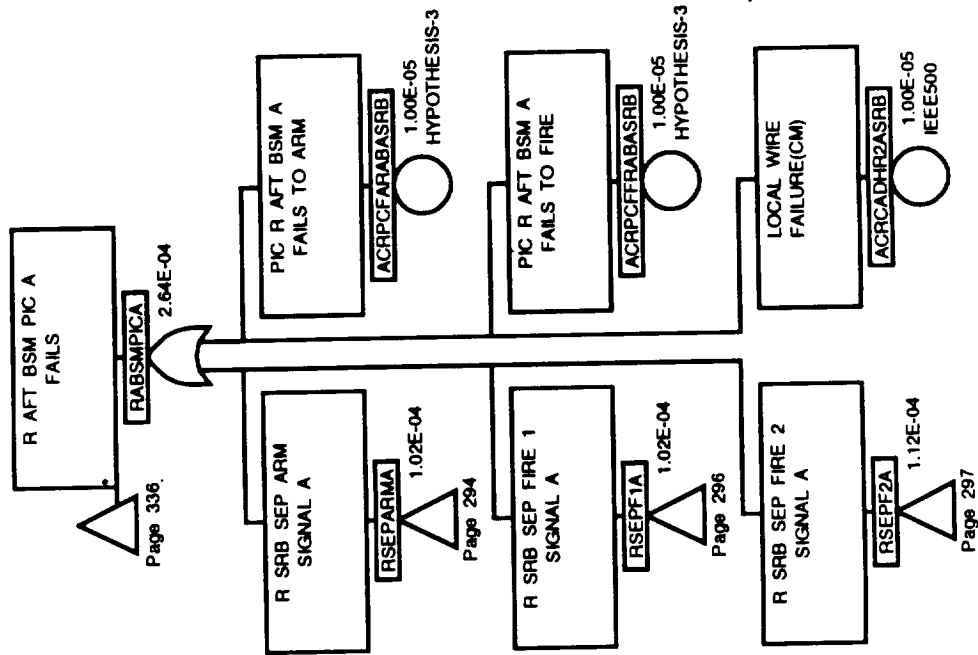


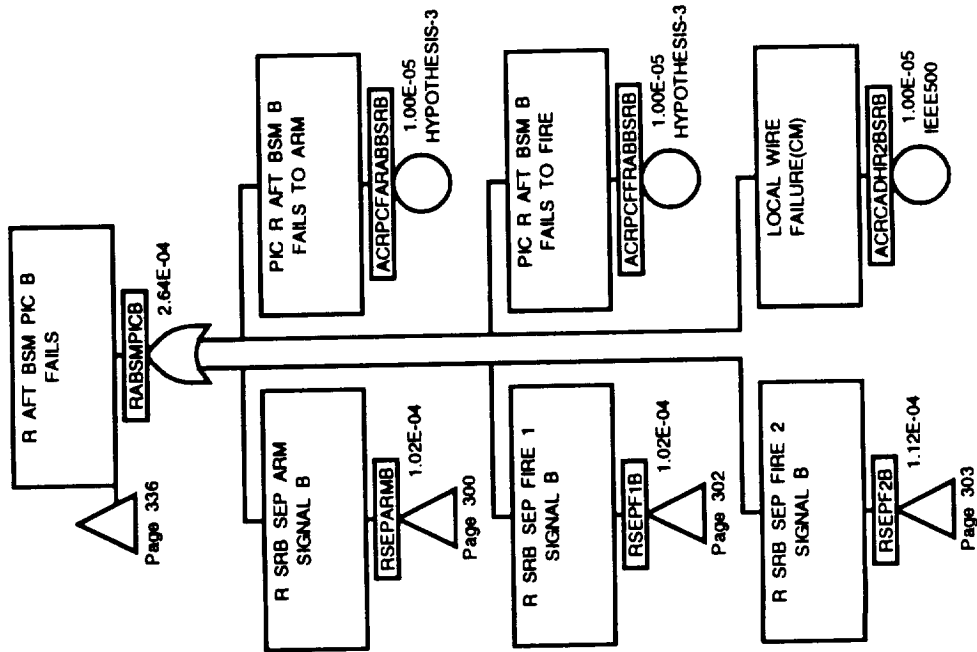


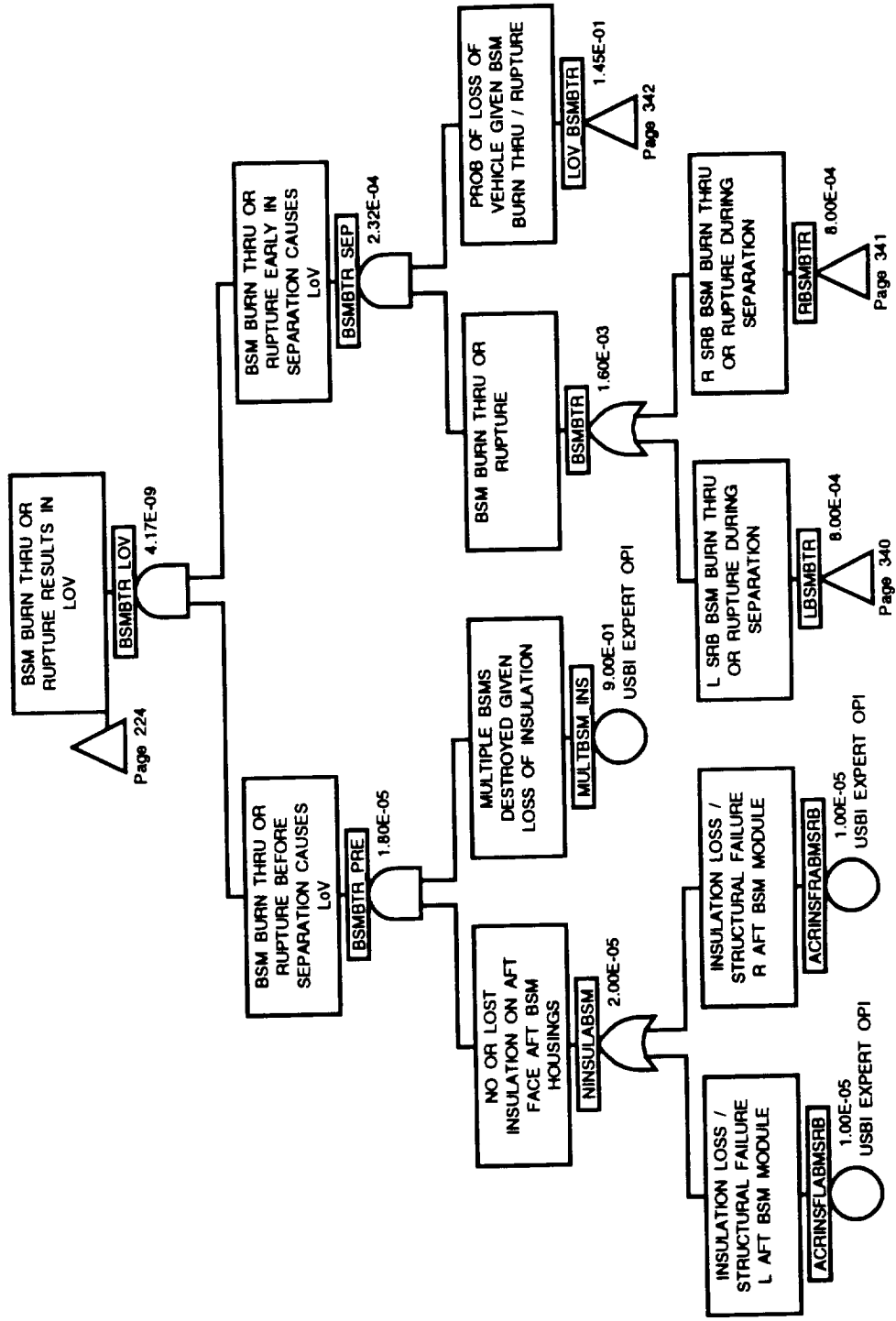
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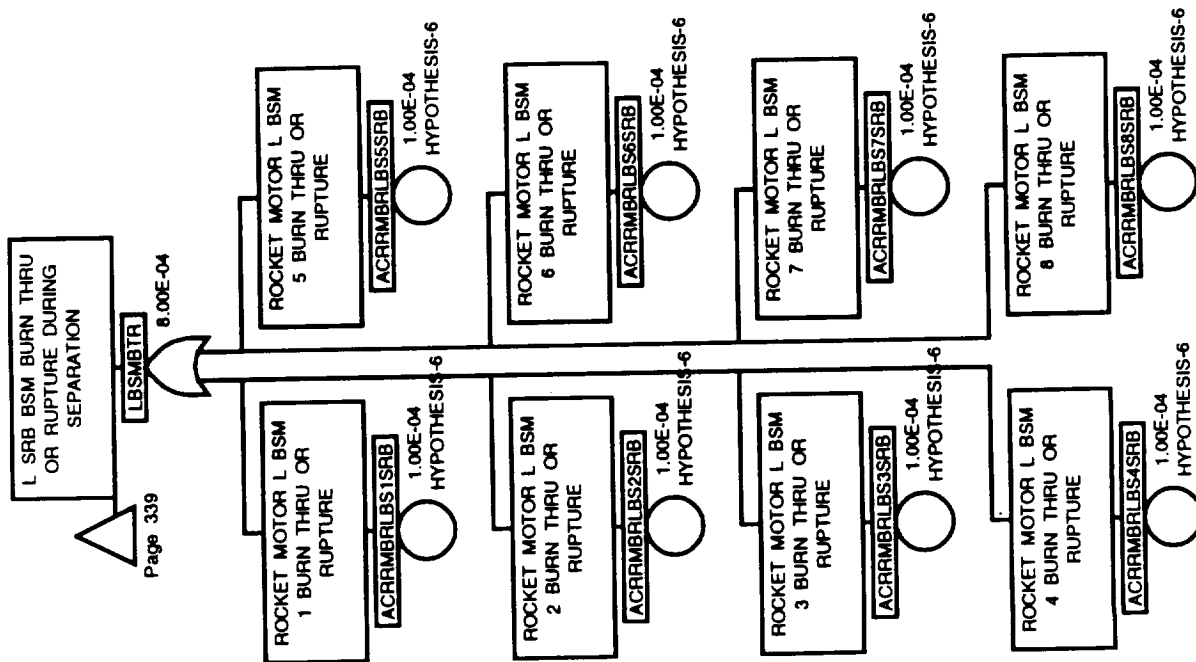
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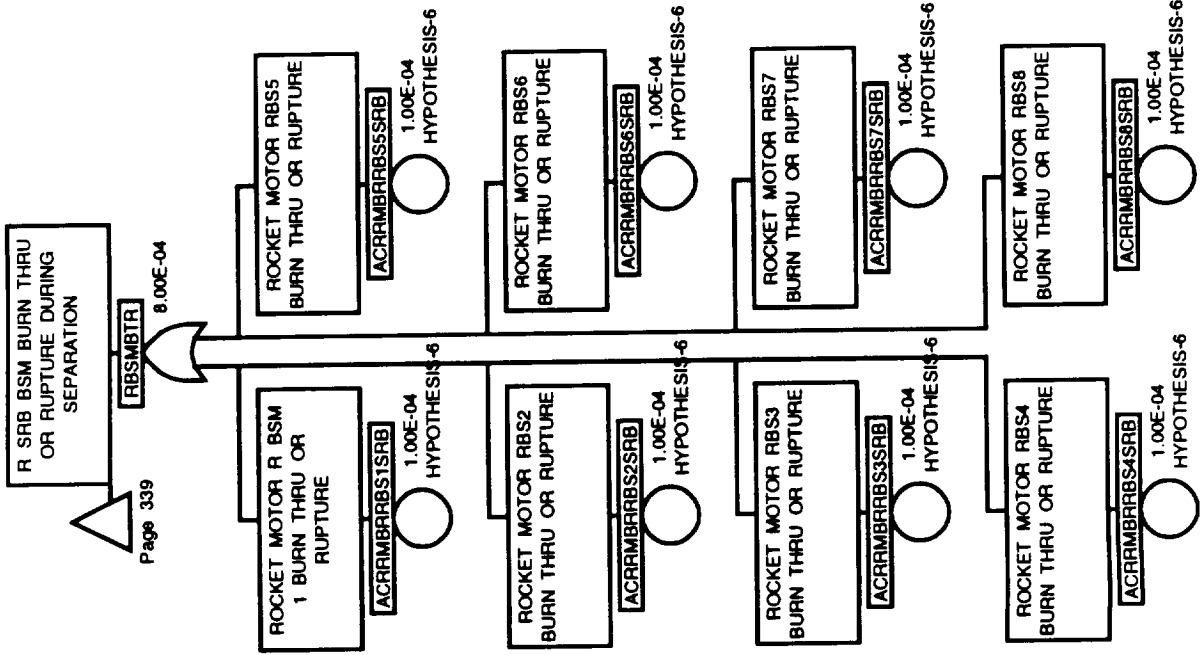
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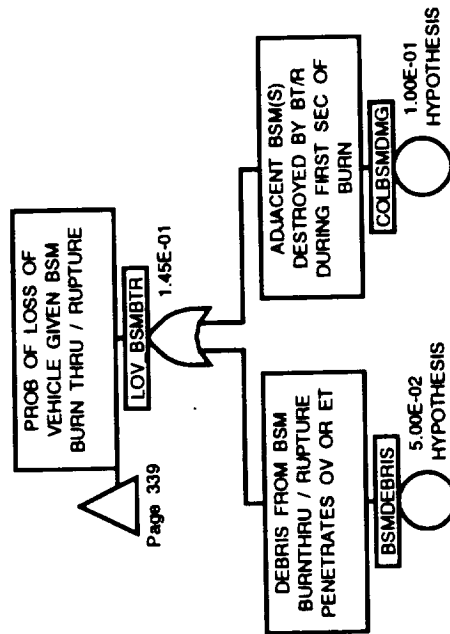




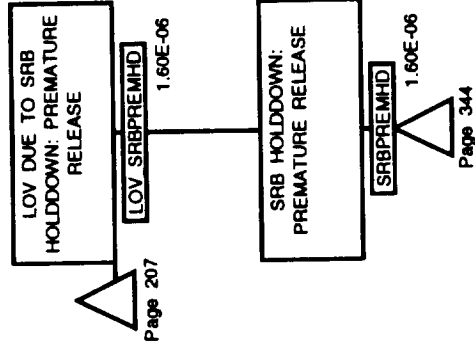


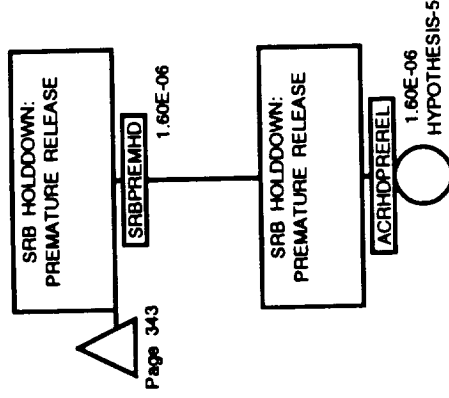


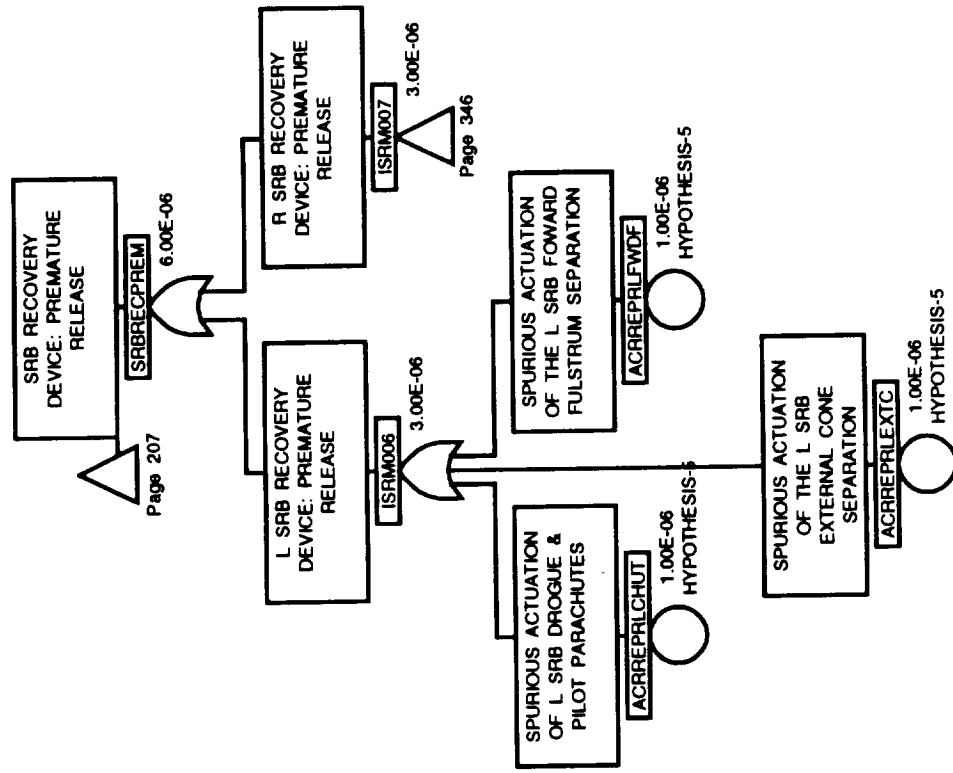


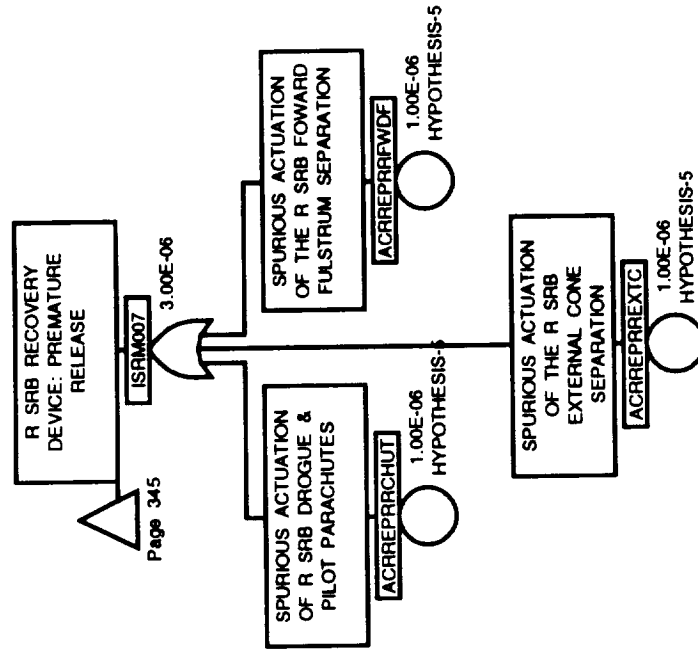


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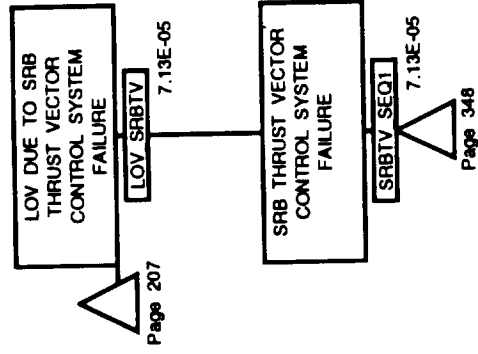


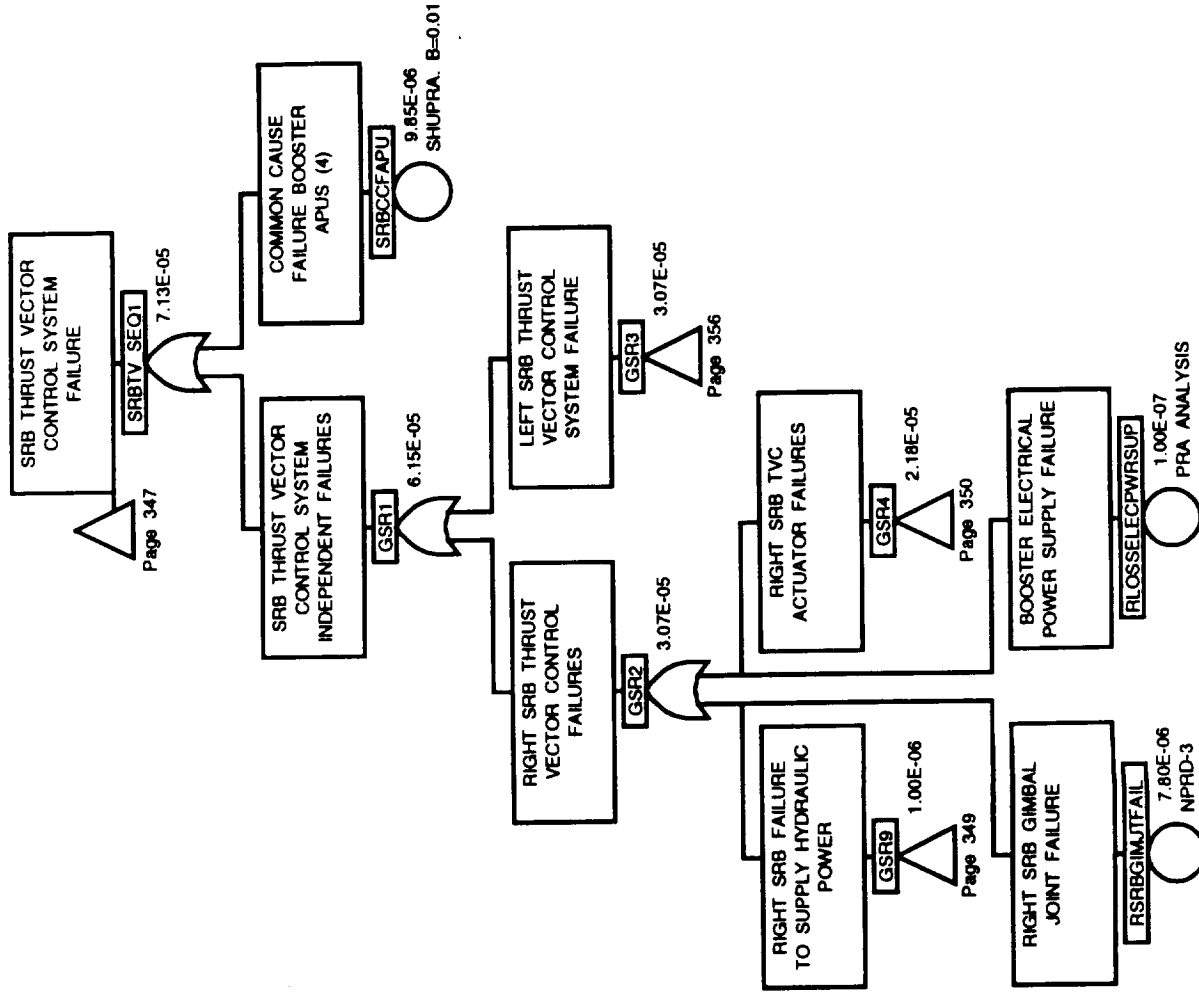


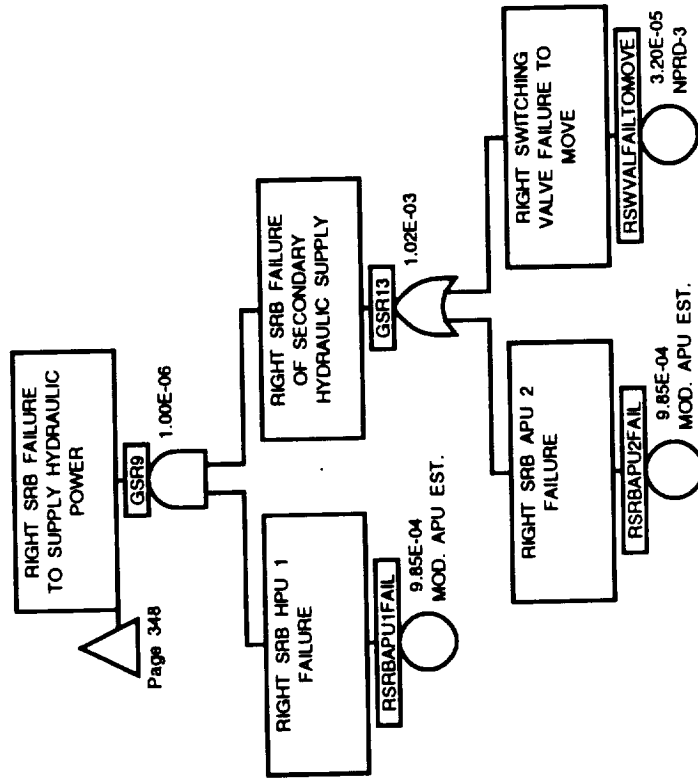


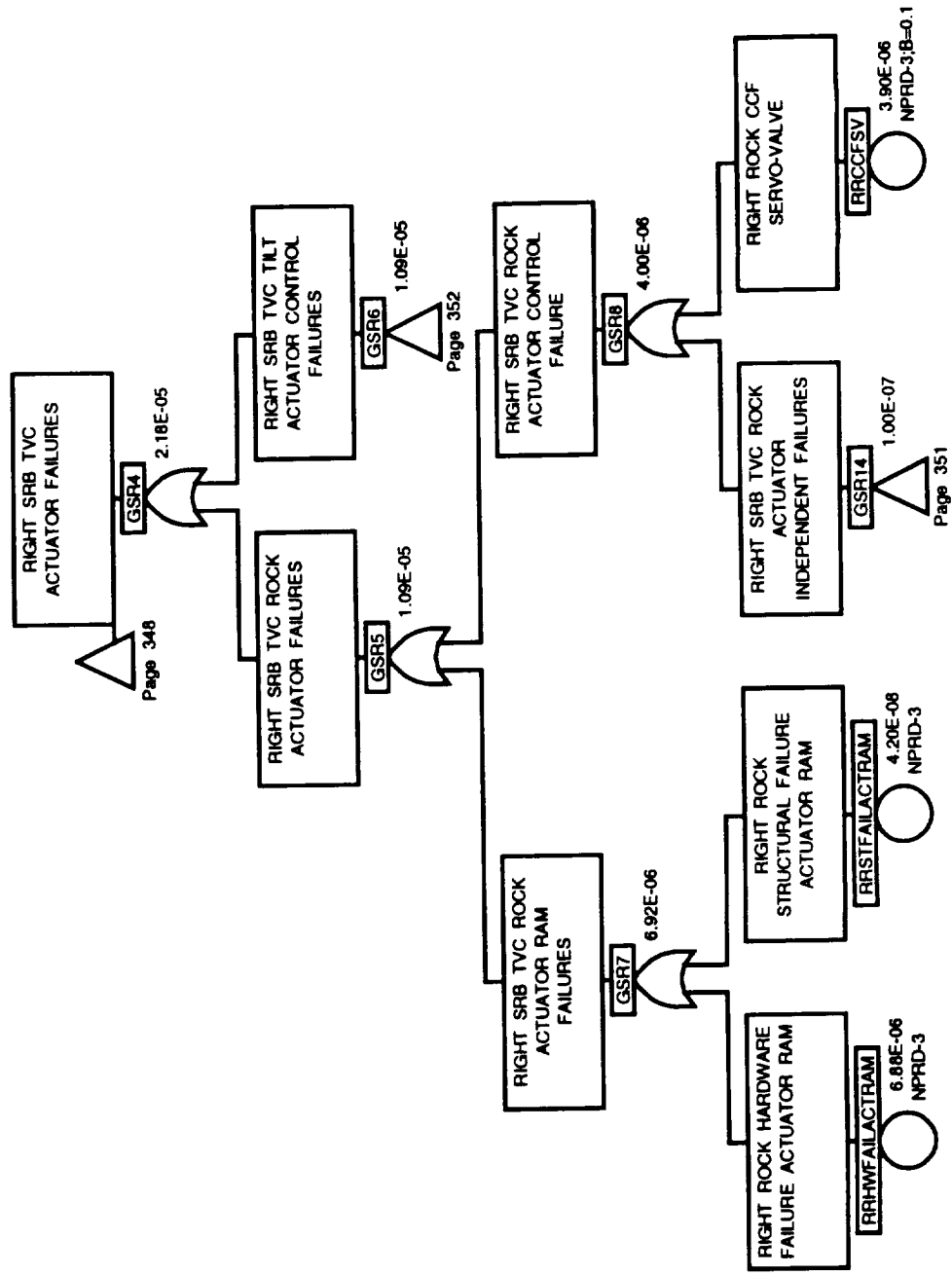


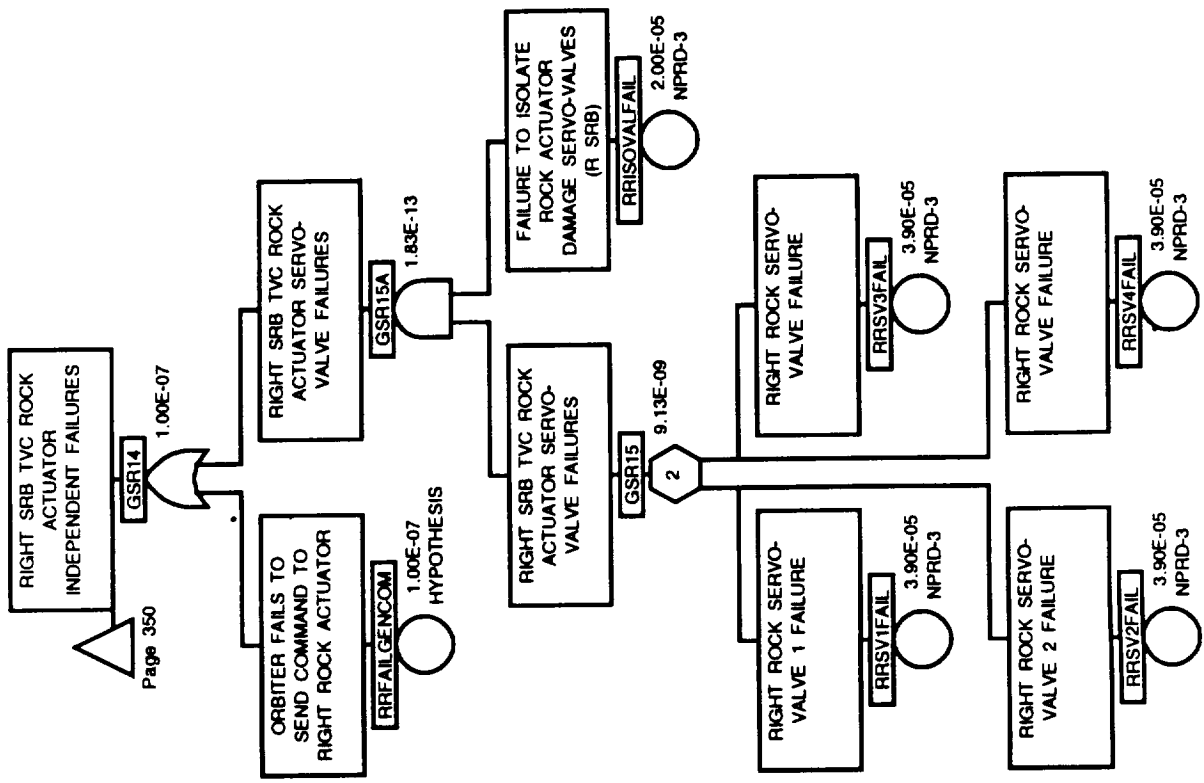
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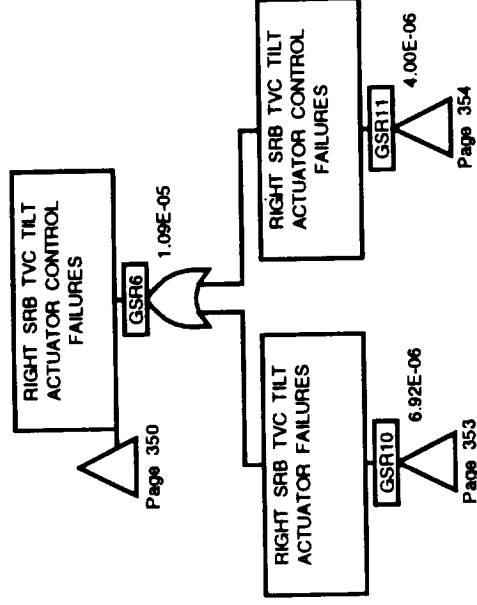


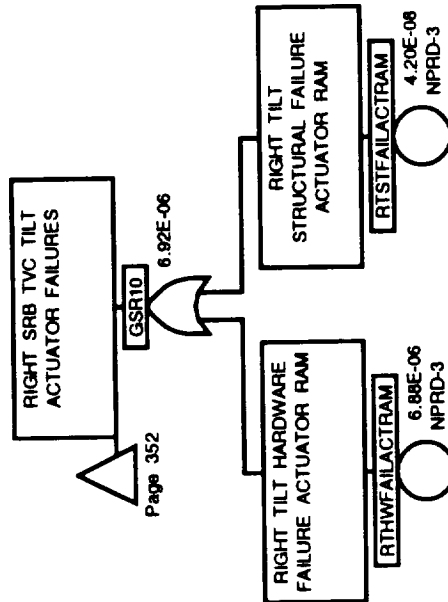




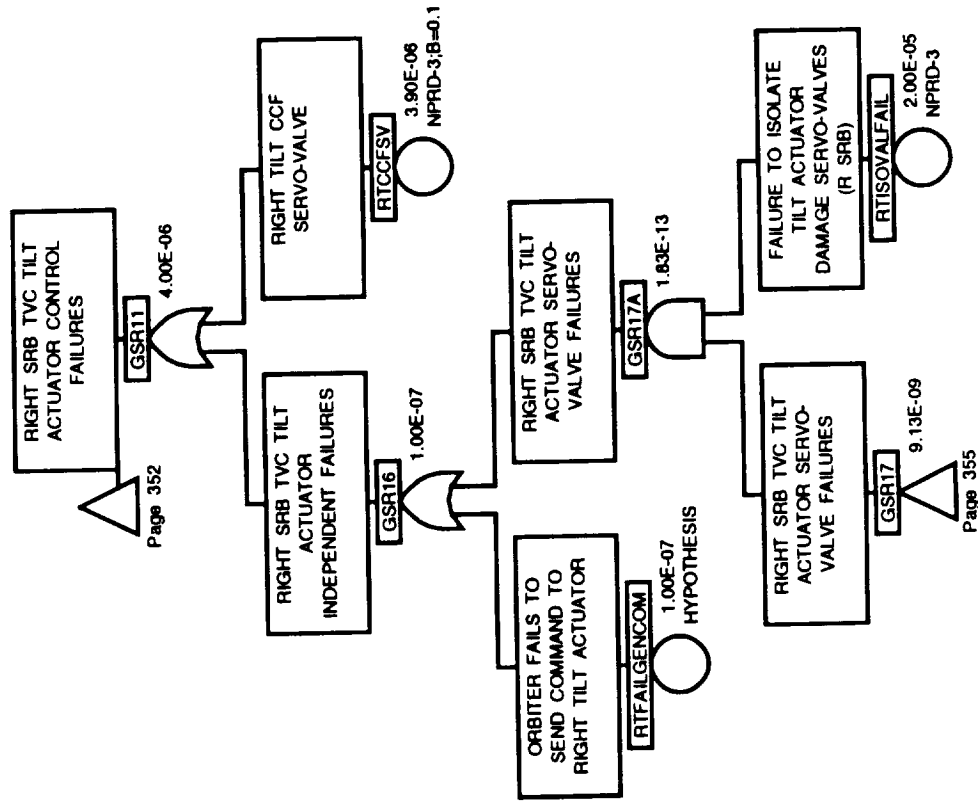


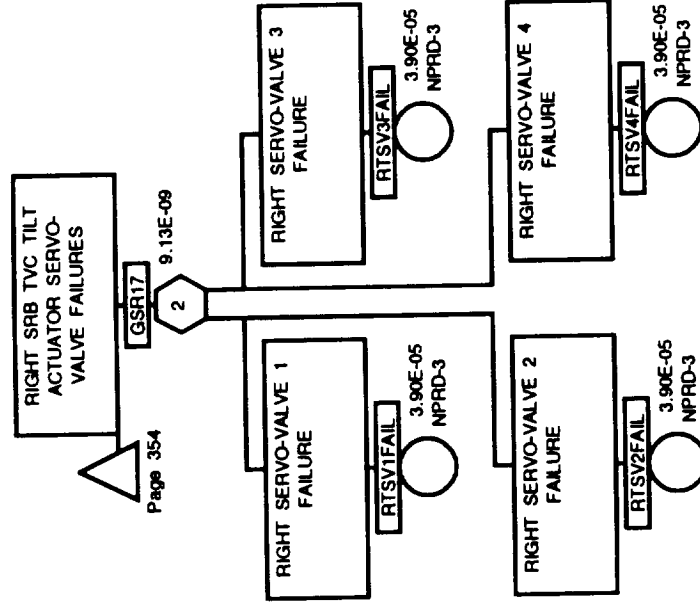
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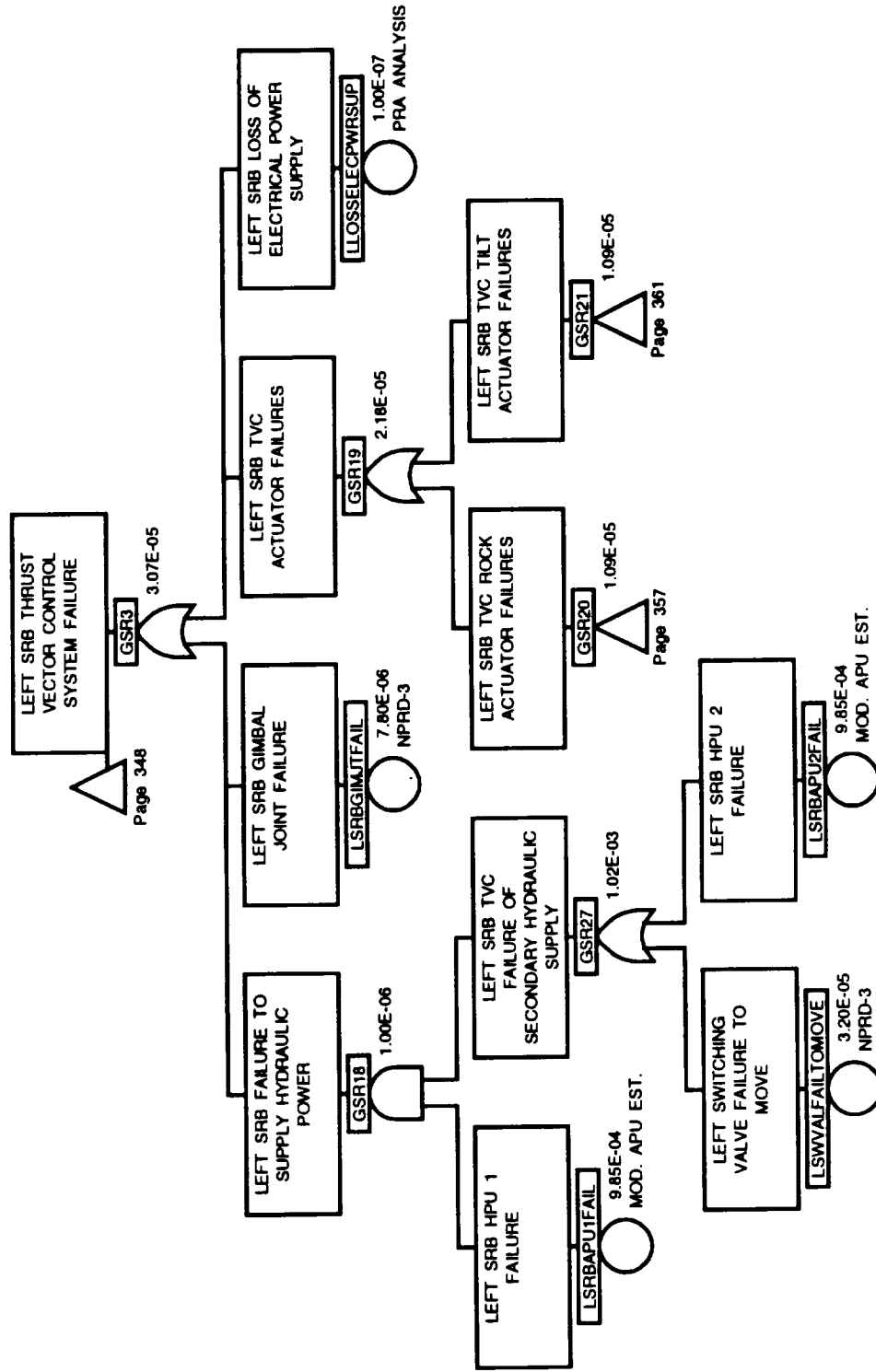


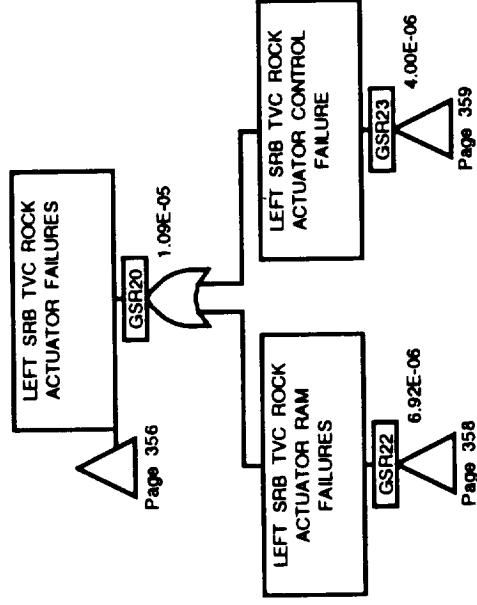
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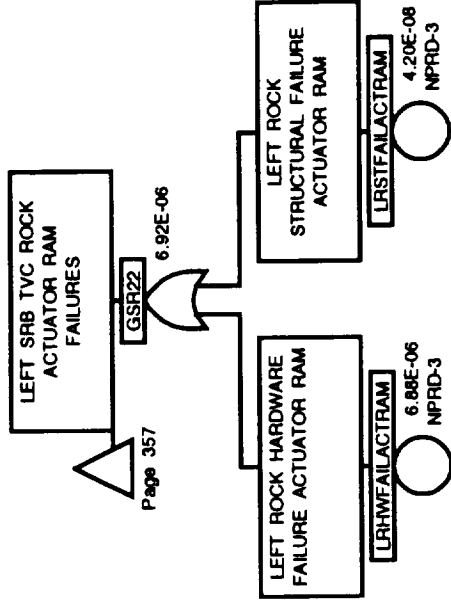




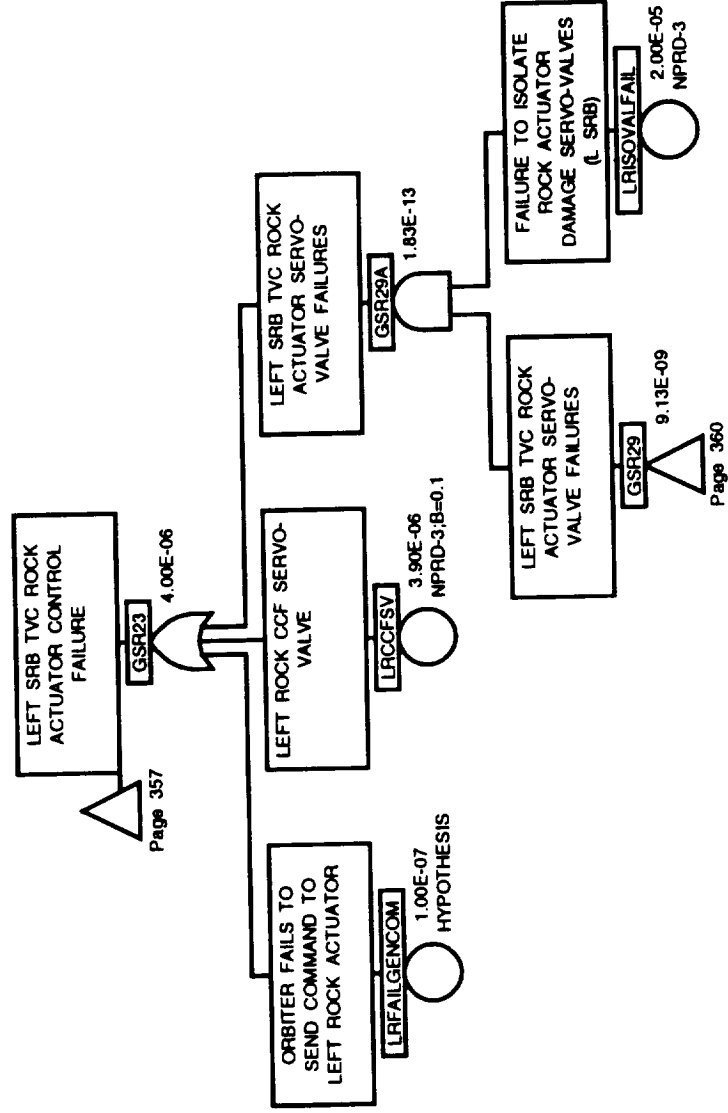
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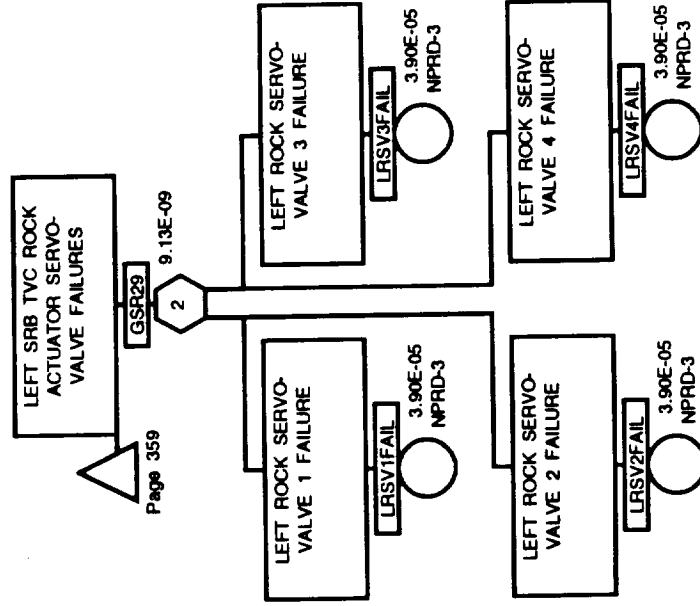


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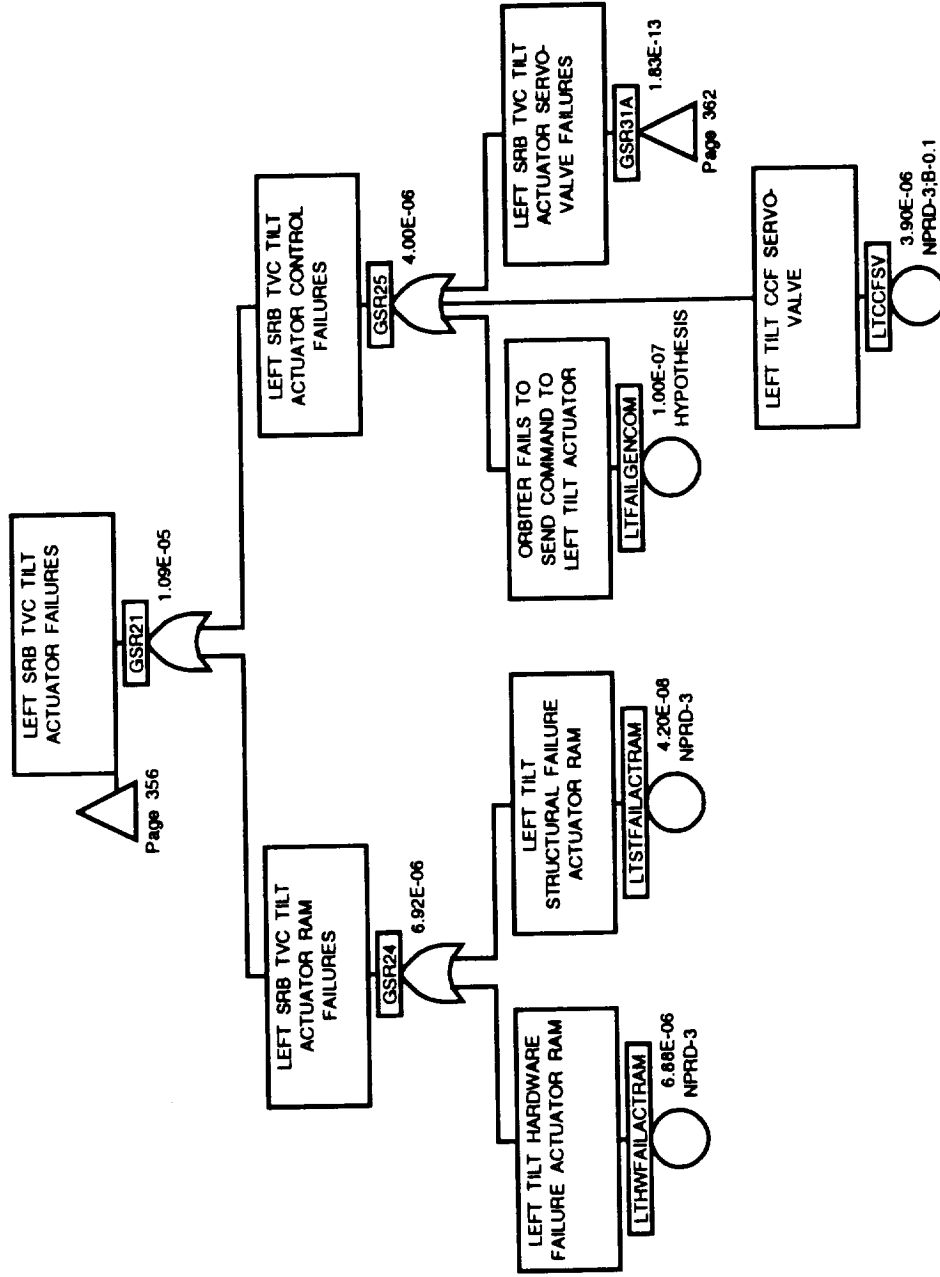


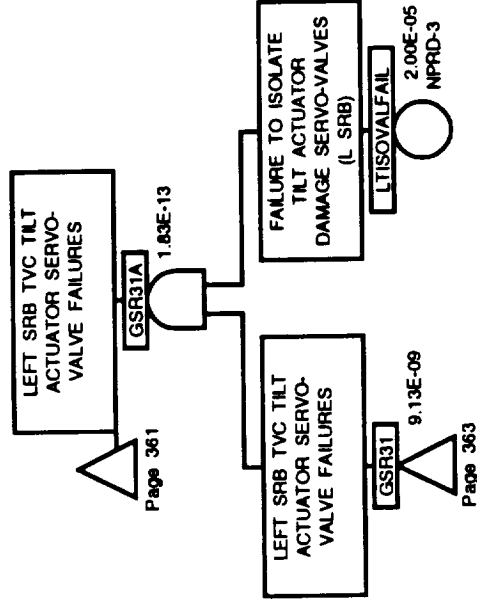
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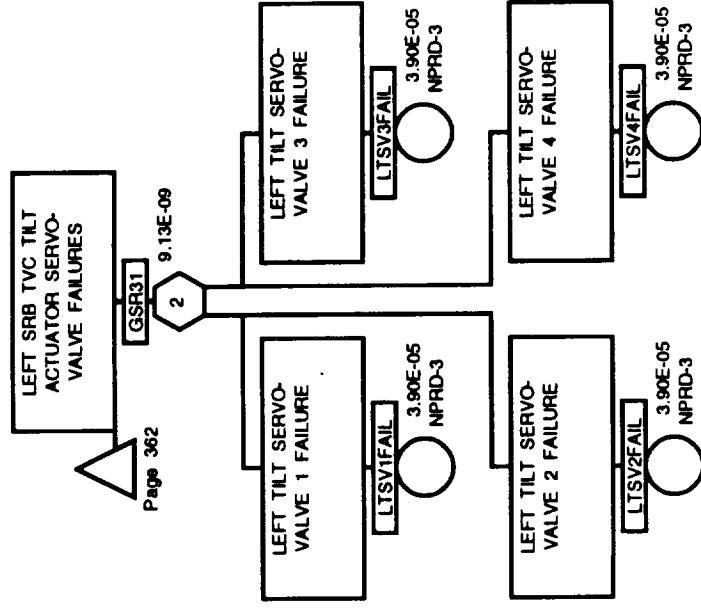
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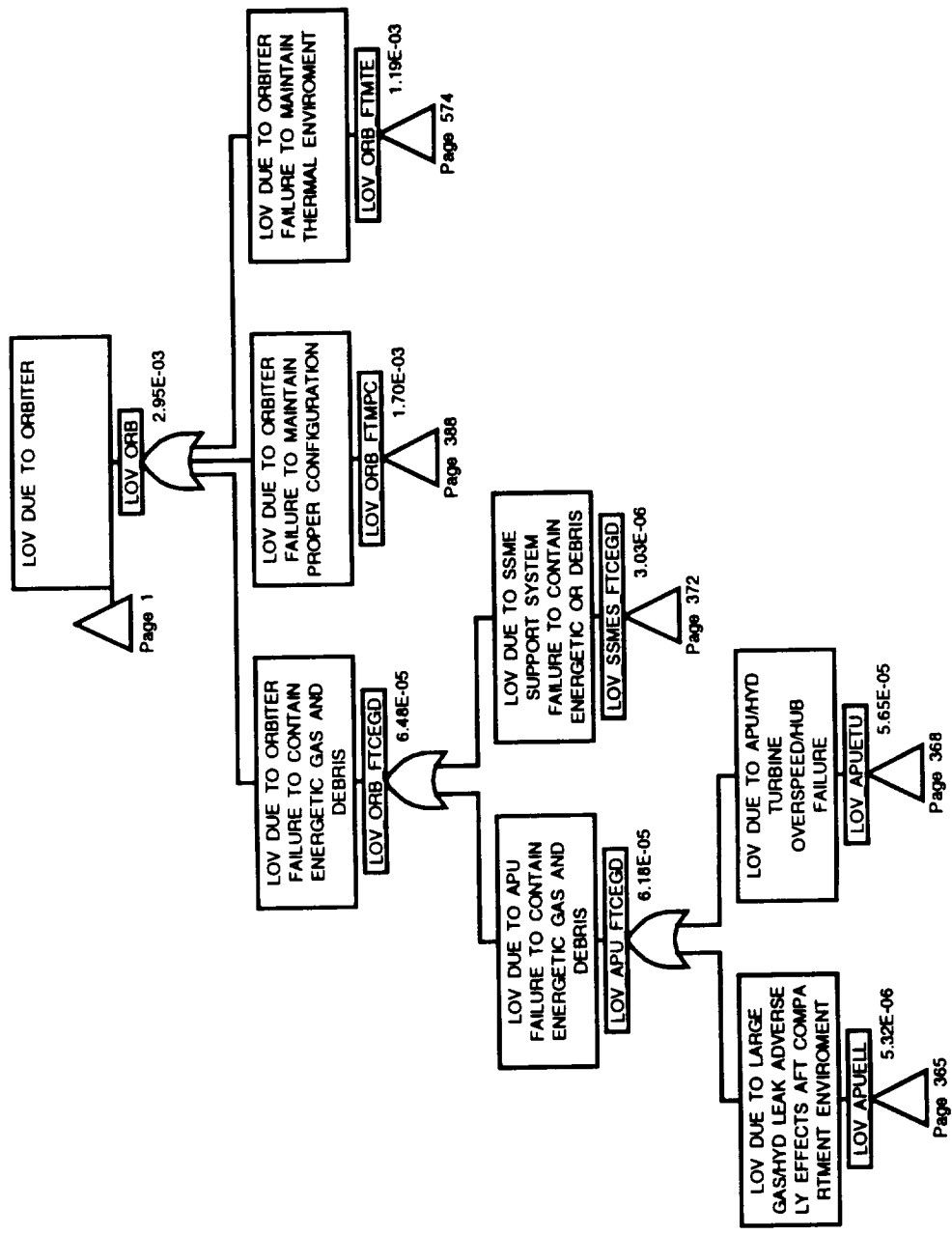
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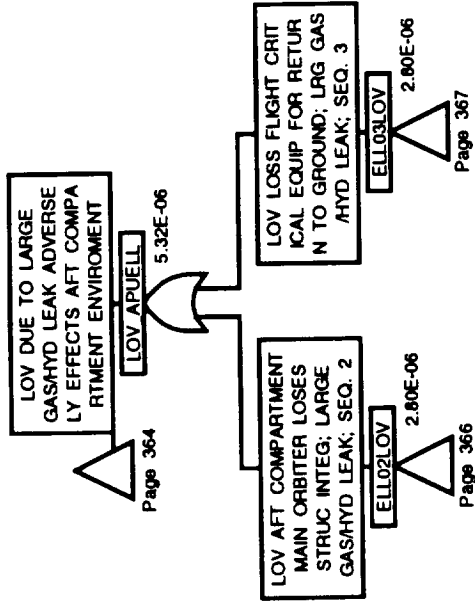


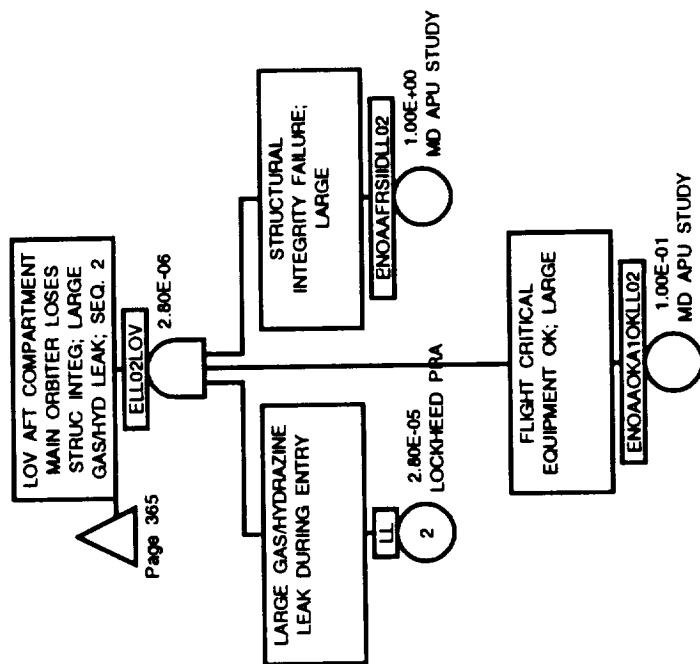


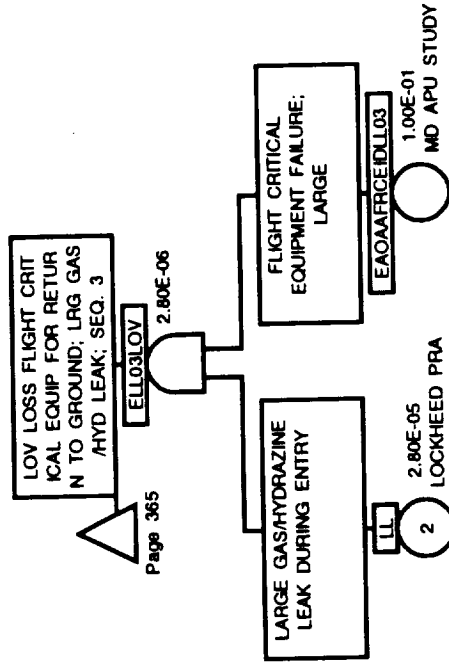


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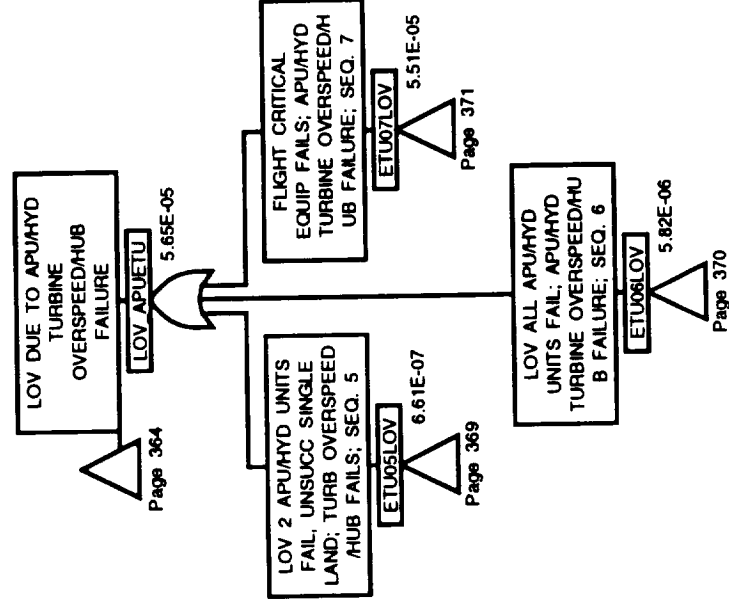


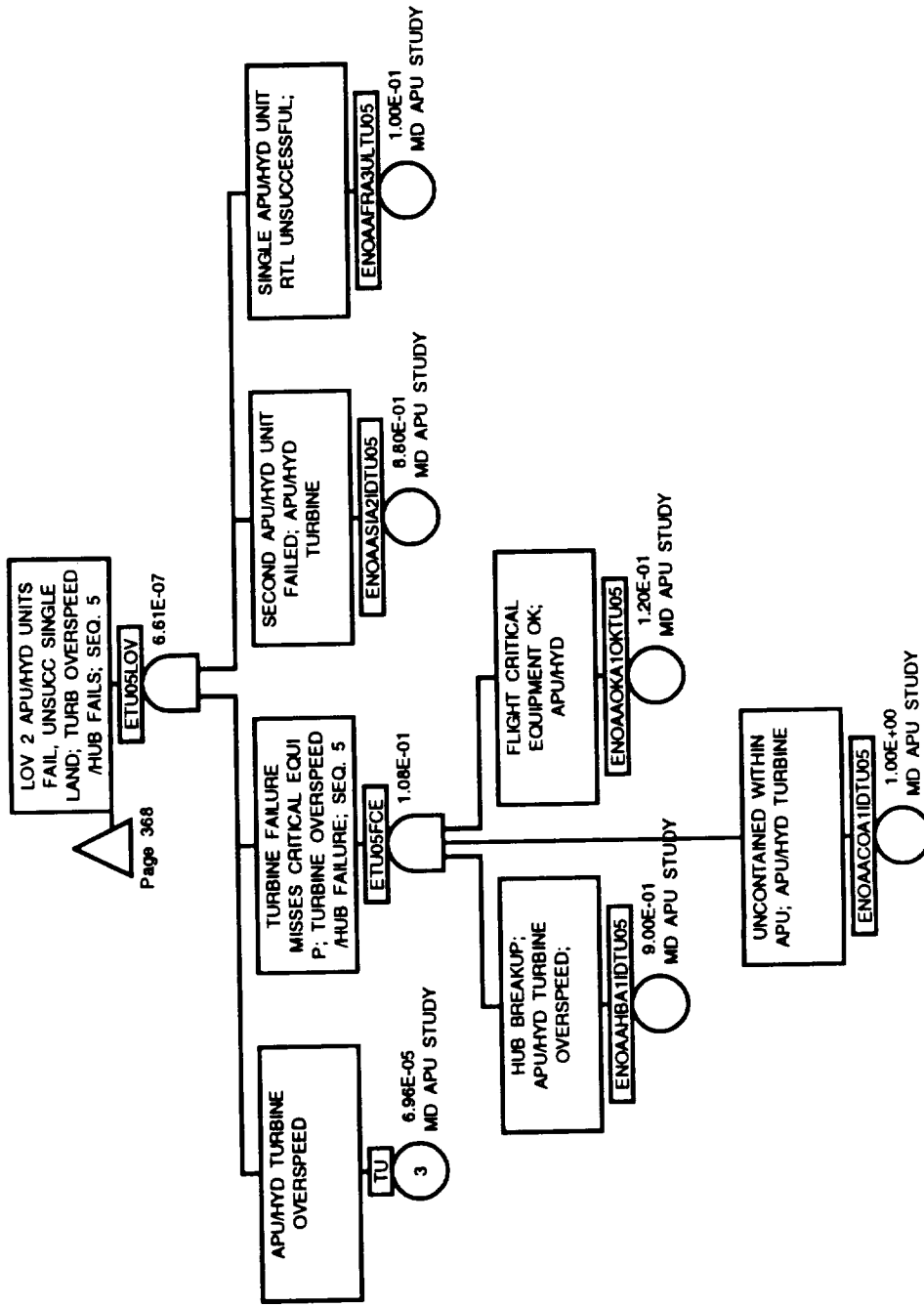


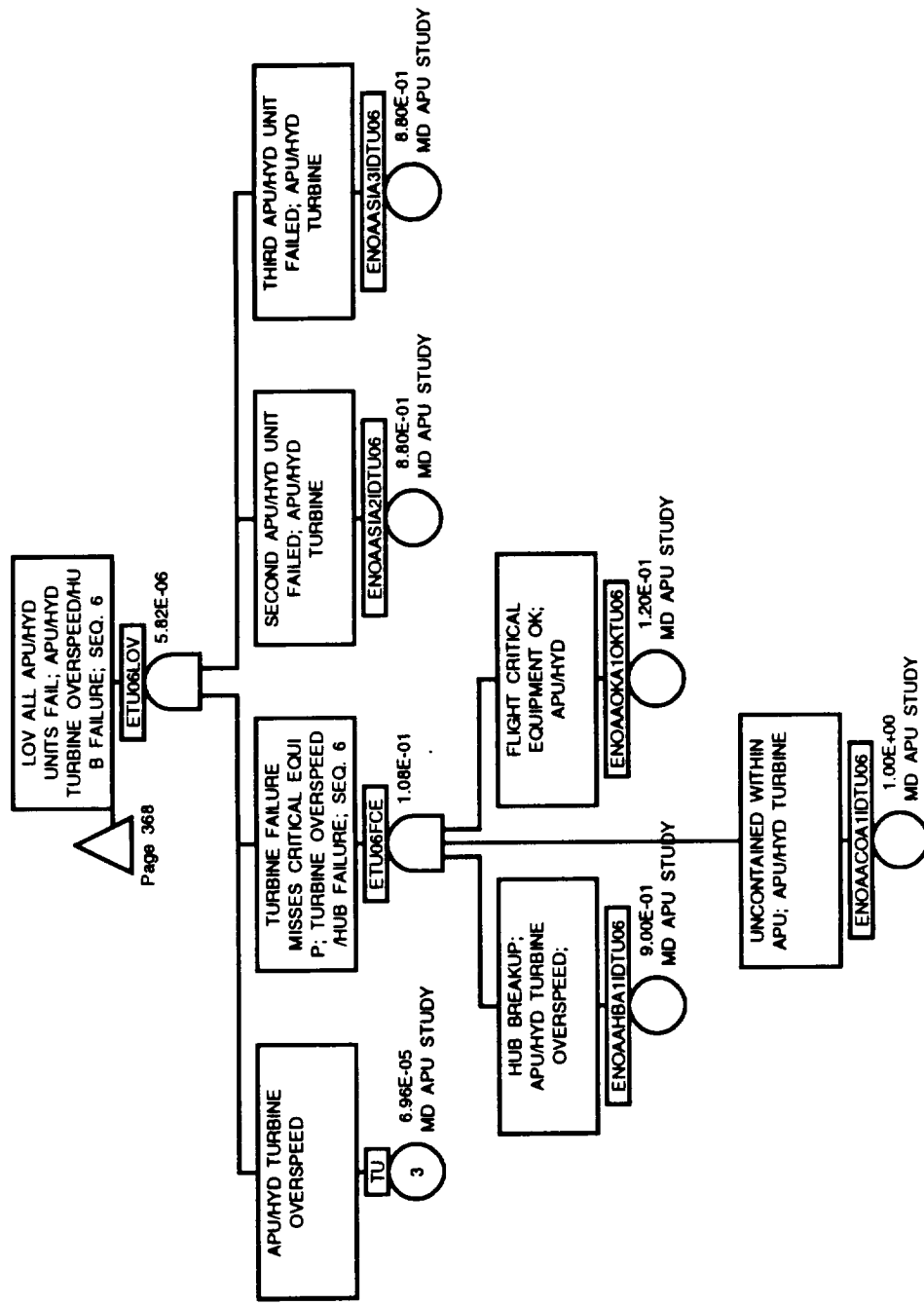


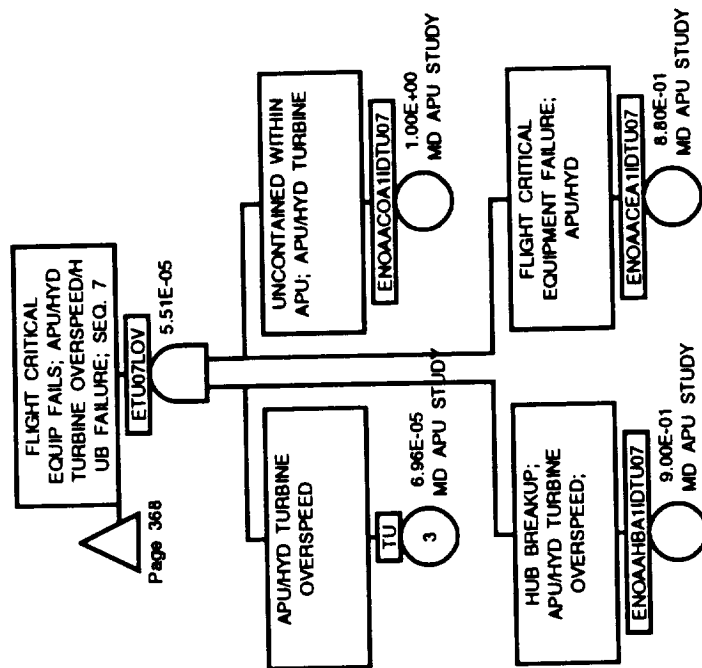


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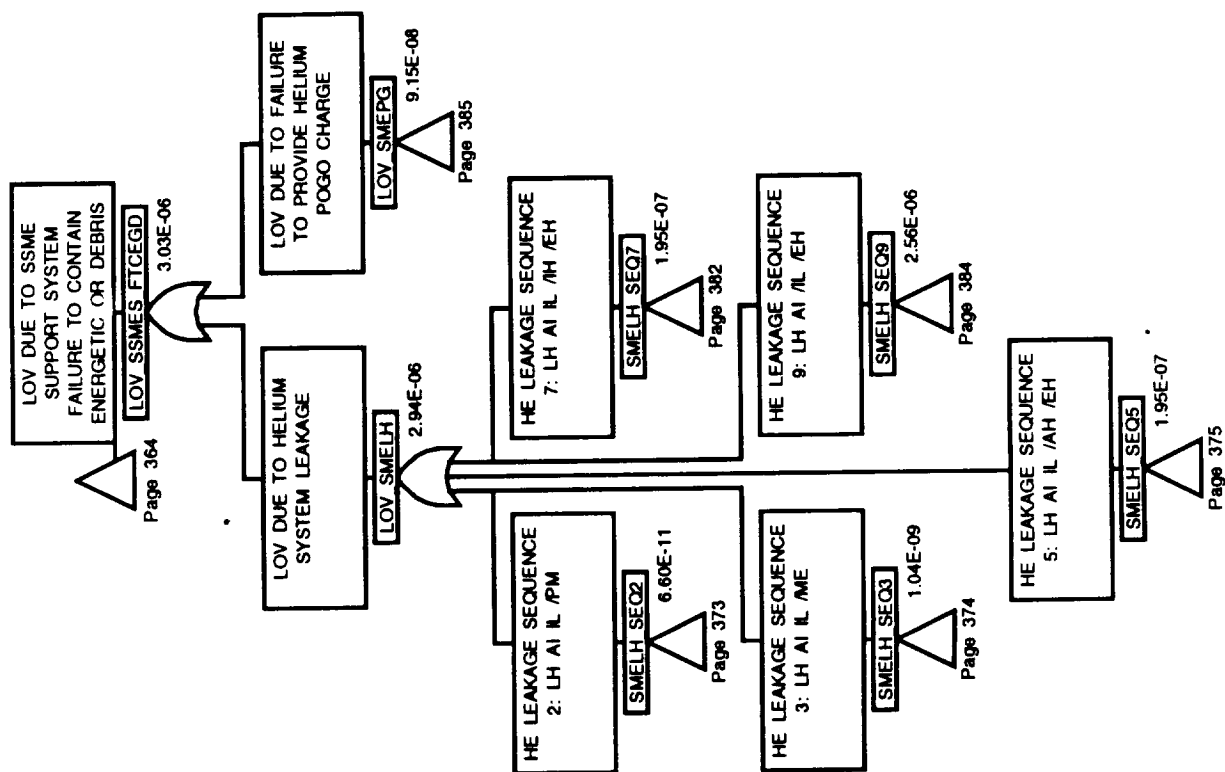


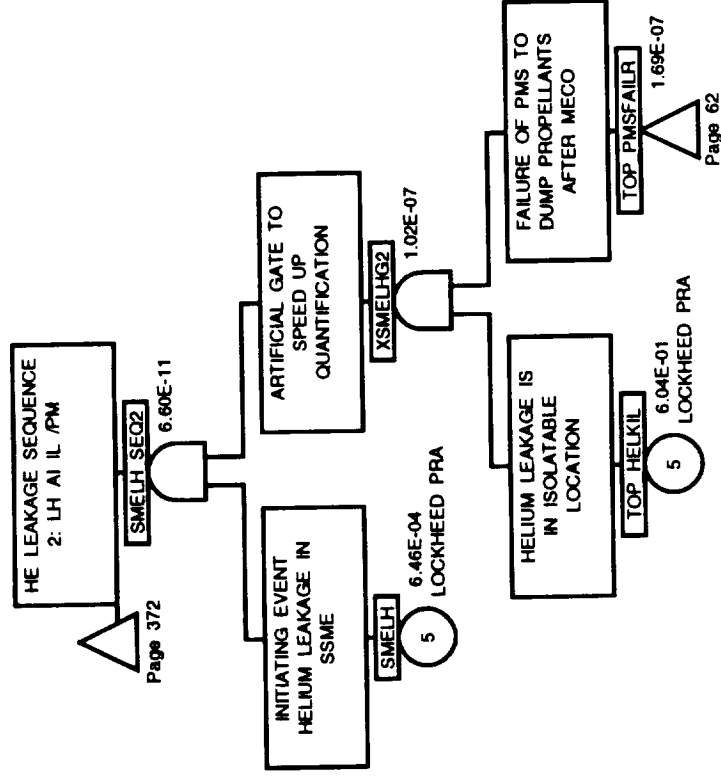


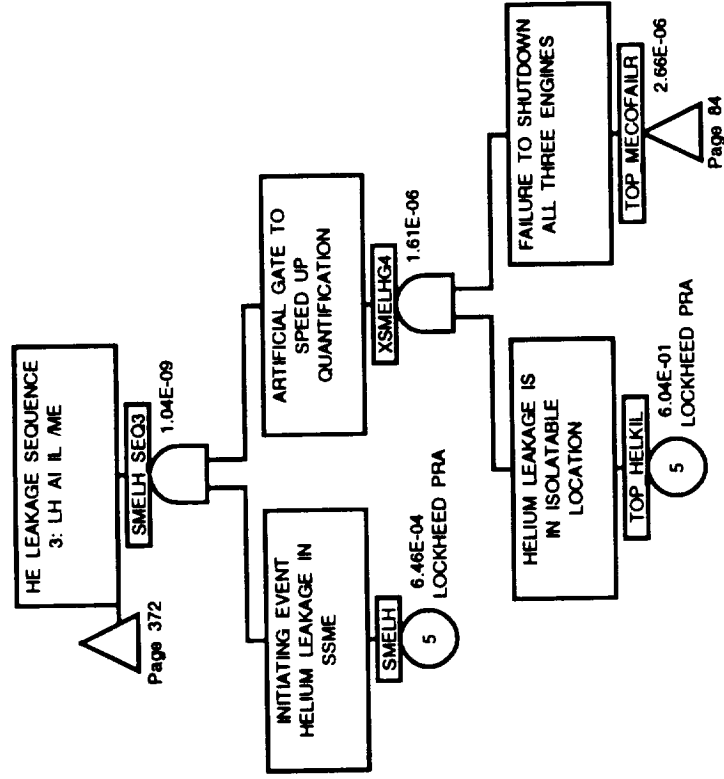


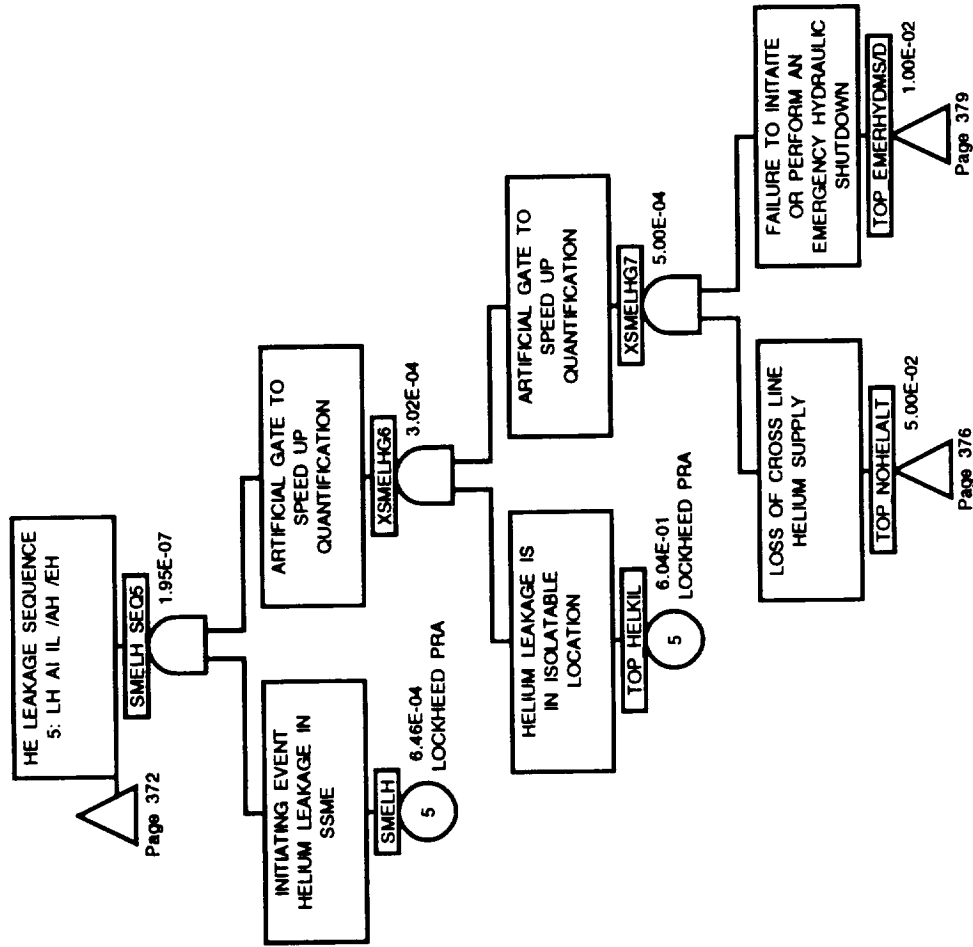


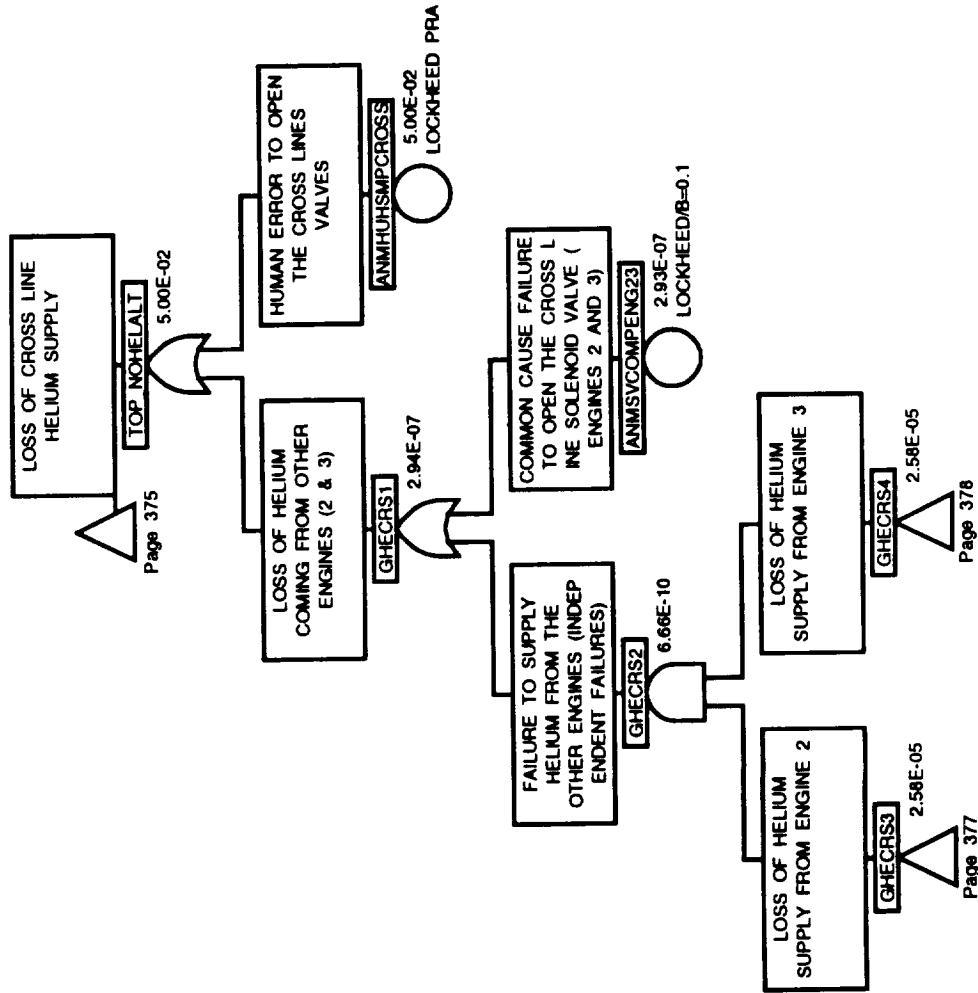
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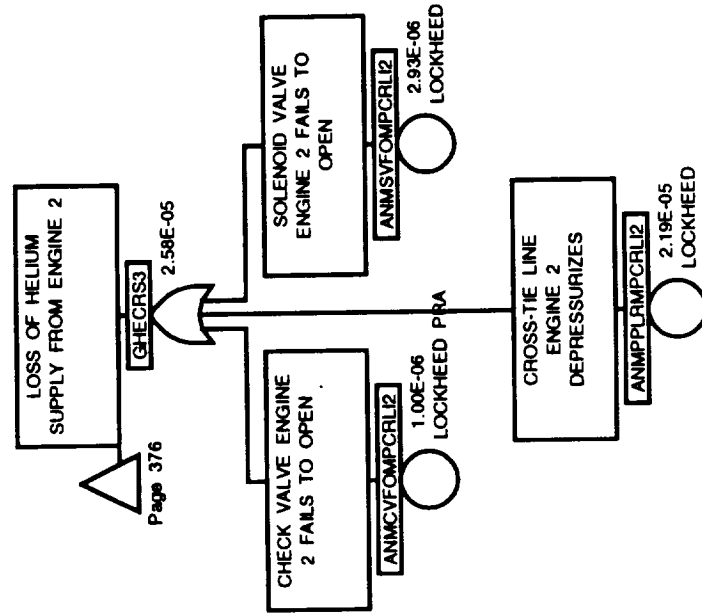




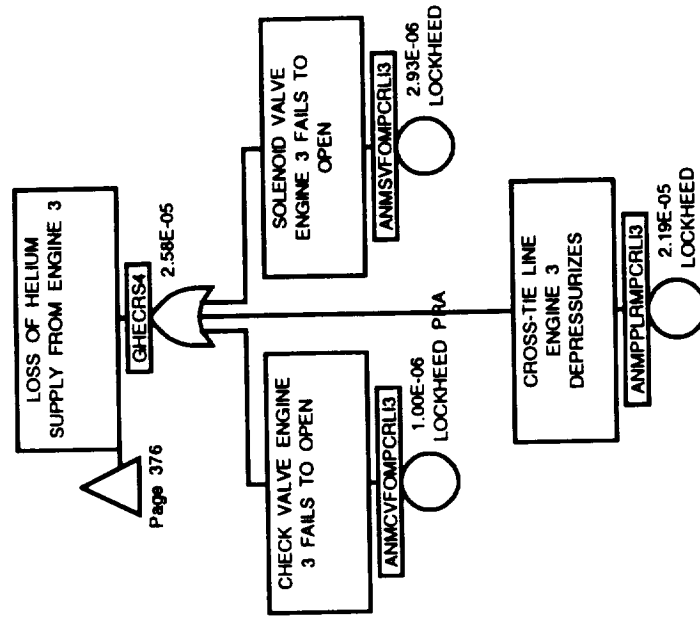




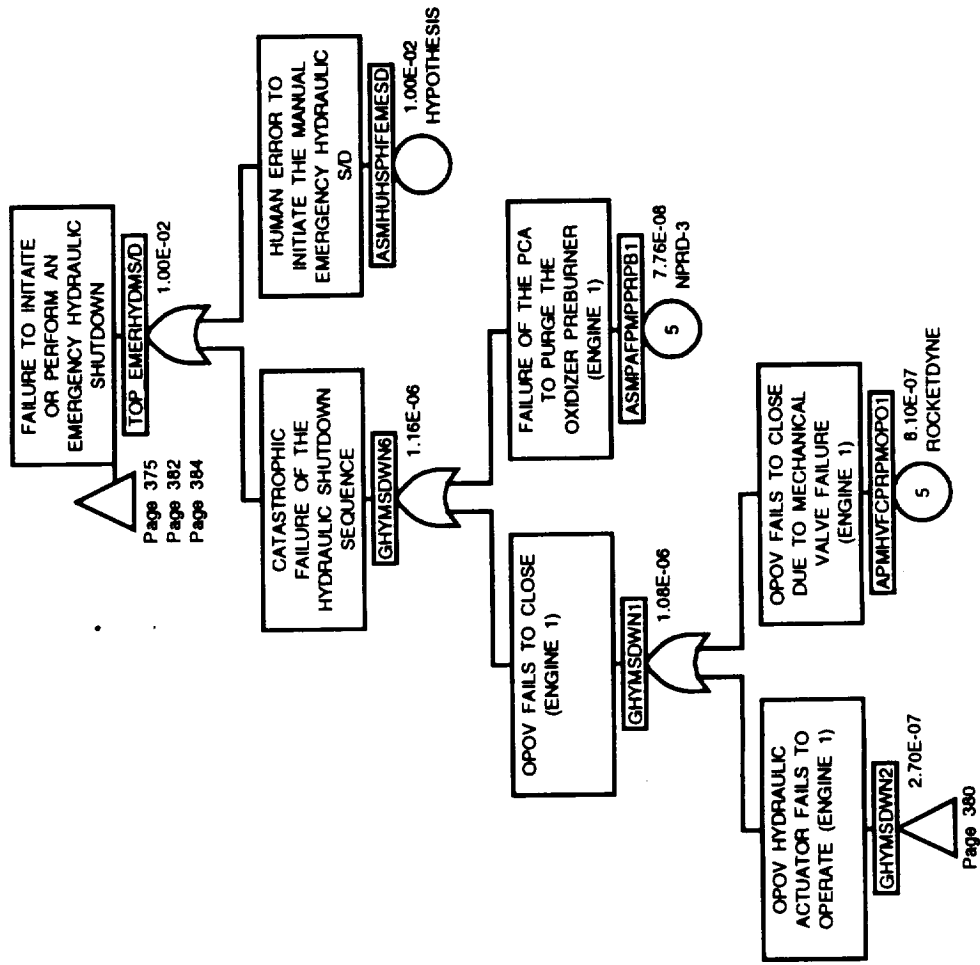


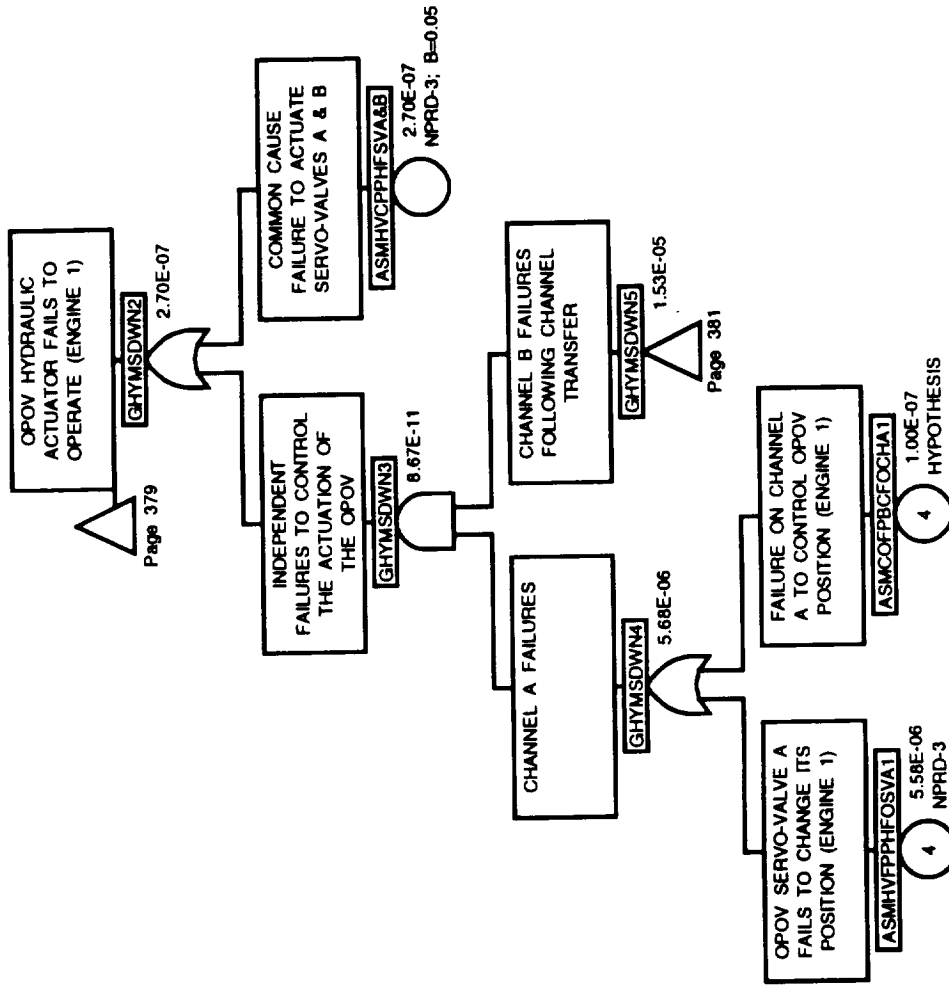


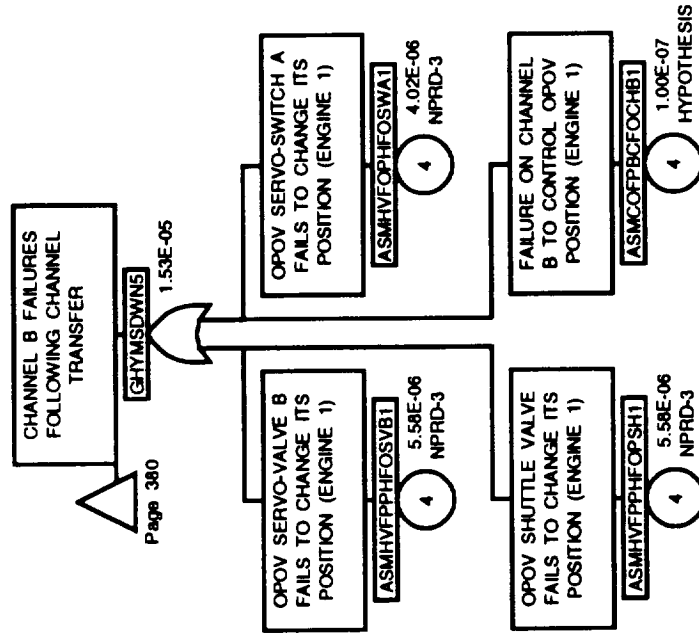
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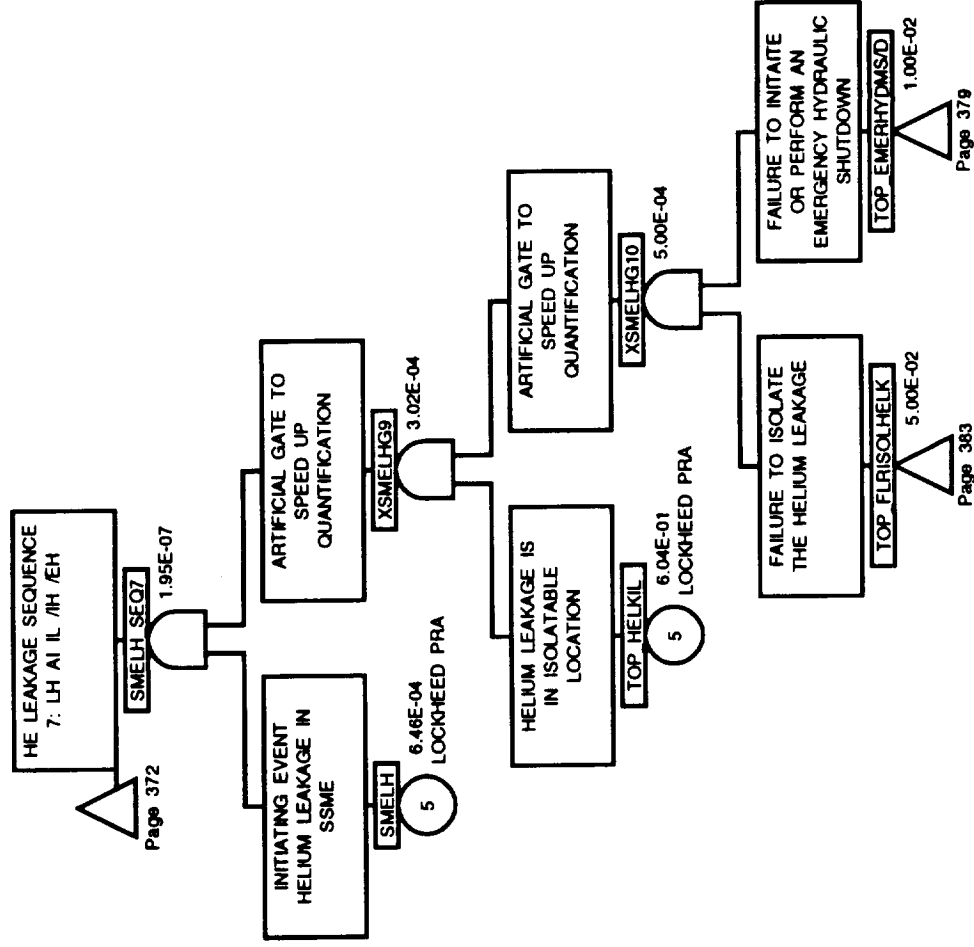


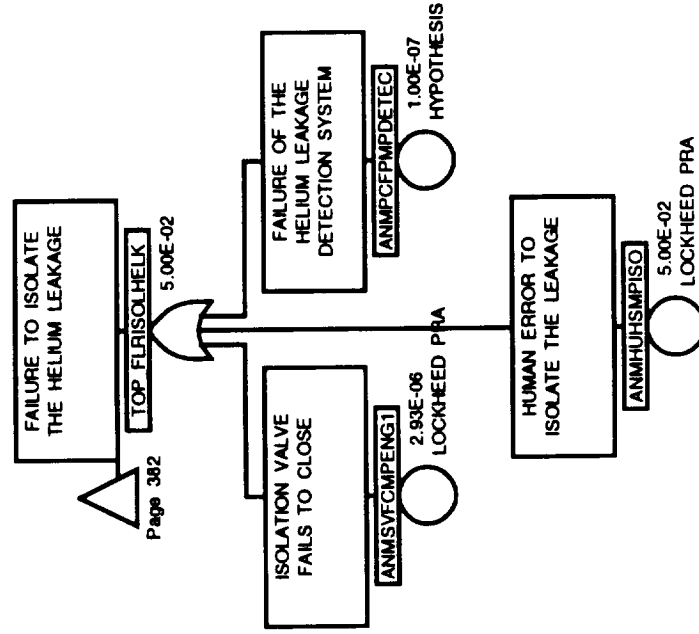
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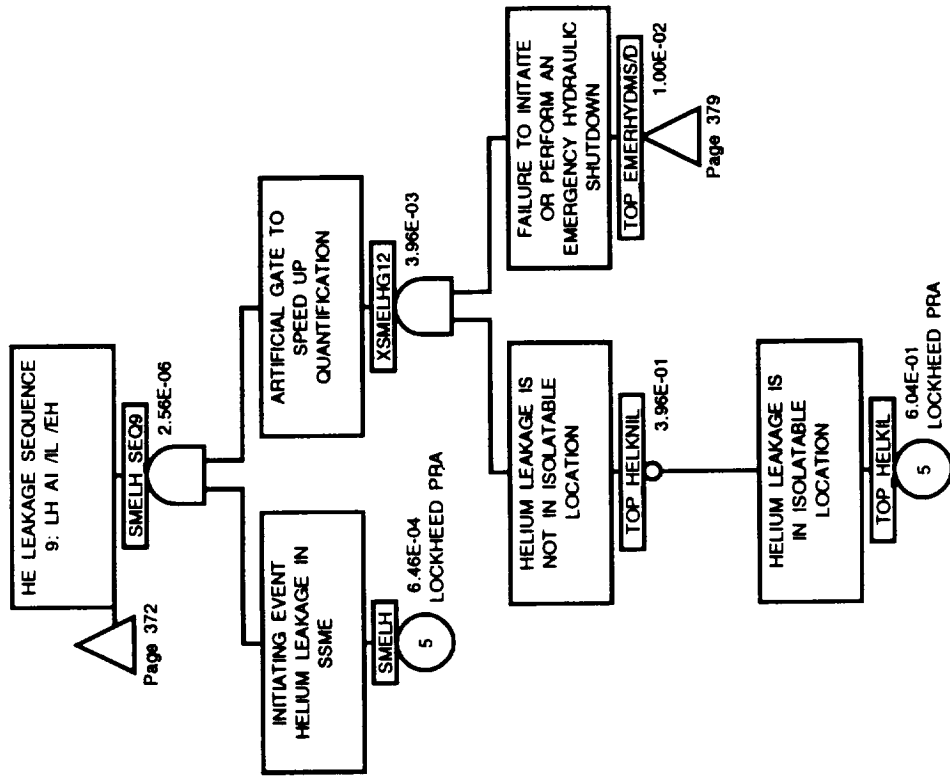


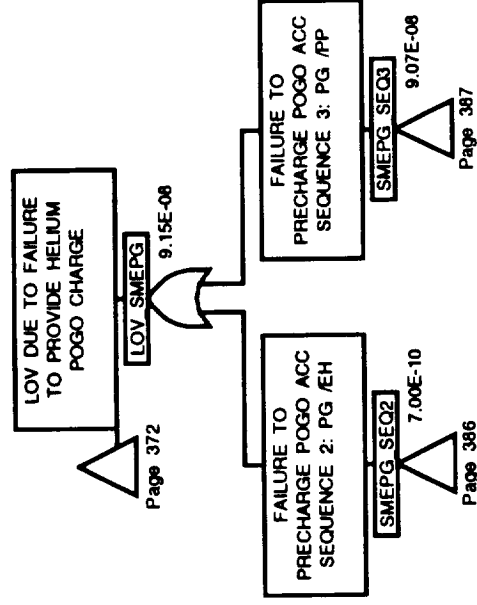


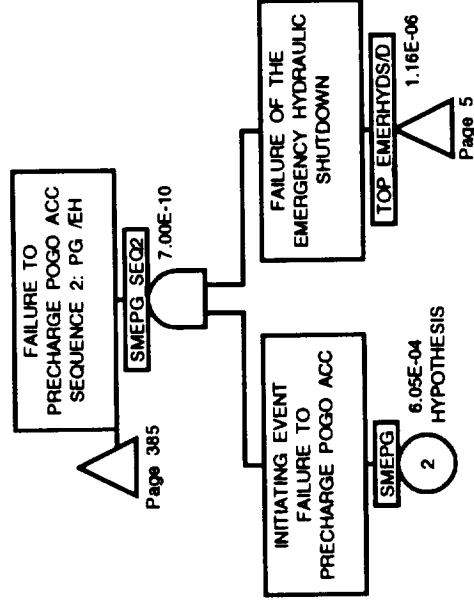


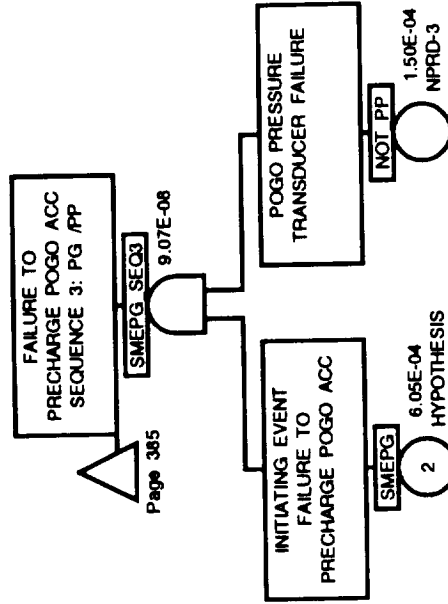


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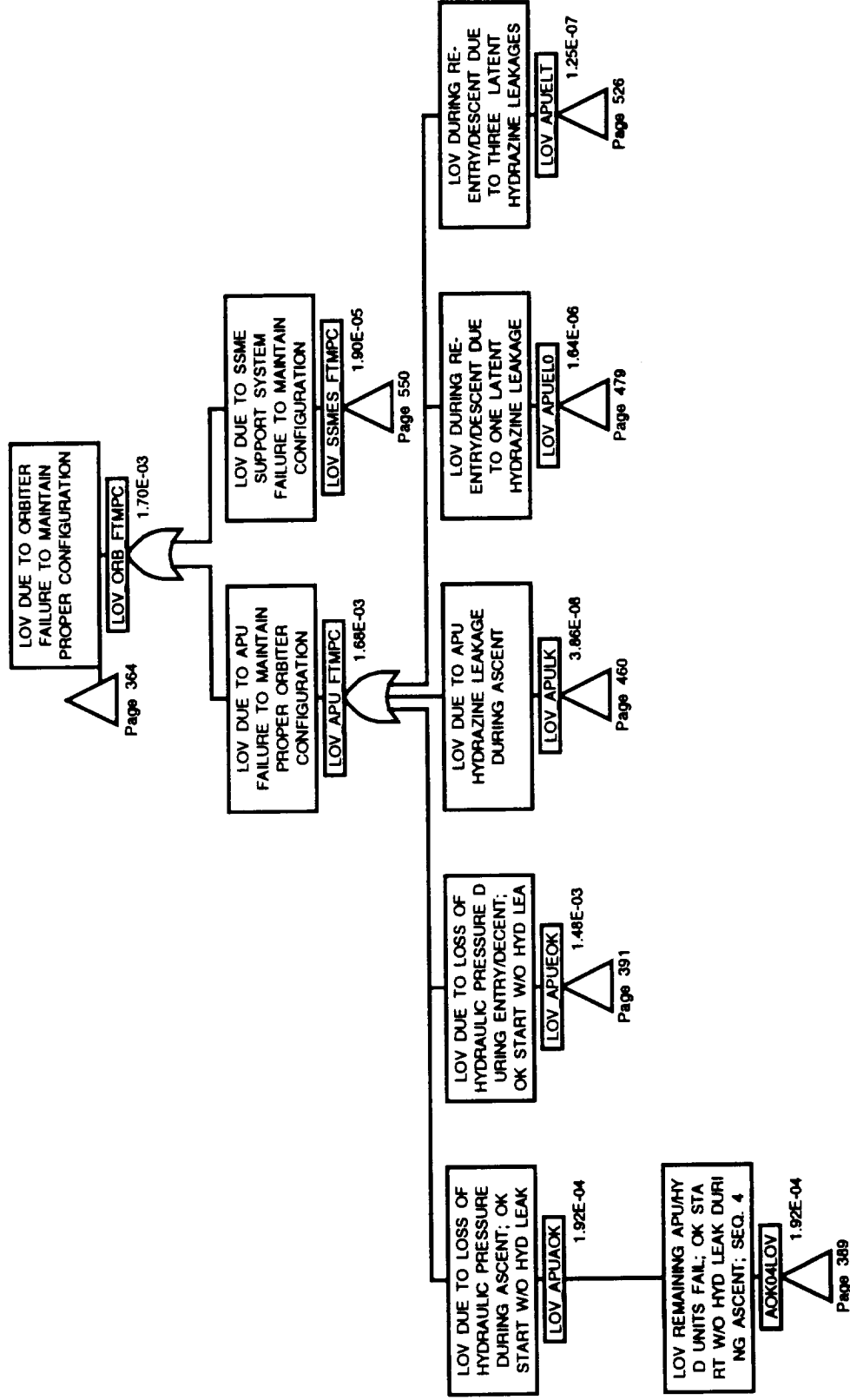


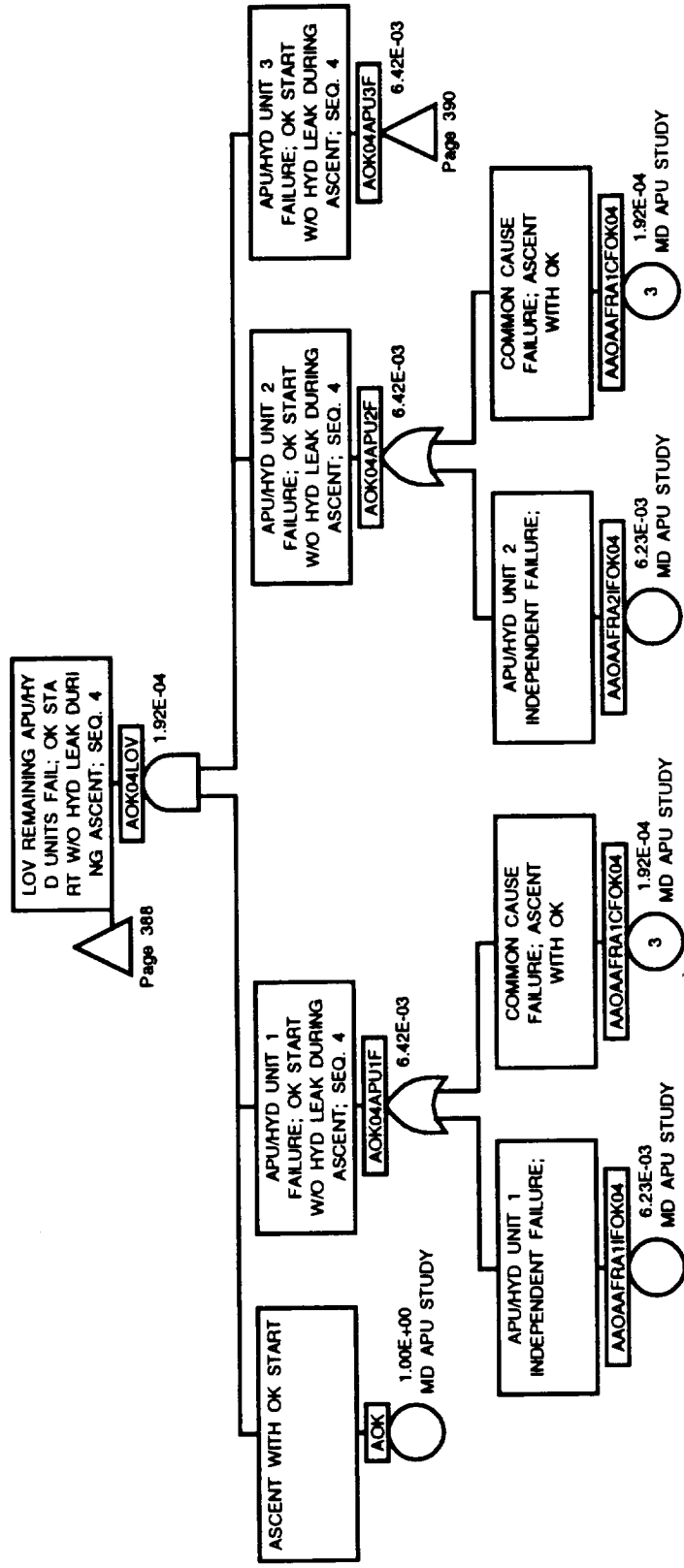


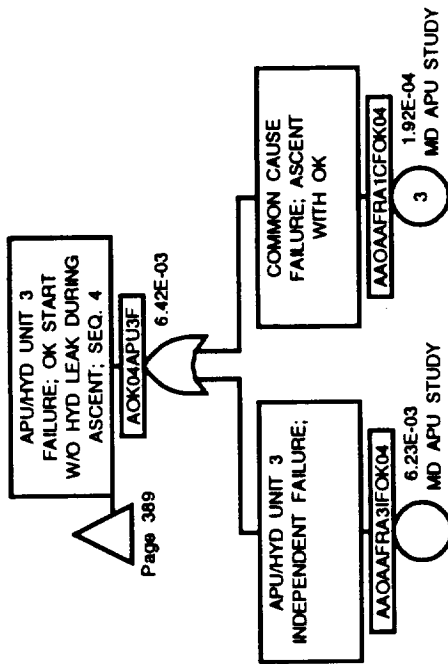




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LOV DUE TO LOSS OF
HYDRAULIC PRESSURE D
URING ENTRY/DECENT.
OK START W/O HYD LEA



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LOV ABUEOK

1.48E-03

SEQUENCE 4 LOV: OK
STATE DURING RTL:
SEQ. 4

FOK04LOV

4.34E-04

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SEQUENCE 5 LOV: OK
STATE DURING RTL:
SEQ. 5

FOK05LOV

3.44E-04

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SEQUENCE 8 LOV: OK
STATE DURING RTL:
SEQ. 8

FOK08LOV

8.88E-05

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SEQUENCE 11 LOV: OK
STATE DURING RTL:
SEQ. 11

FOK11LOV

9.78E-06

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SEQUENCE 12 LOV: OK
STATE DURING RTL:
SEQ. 12

FOK12LOV

3.32E-05

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SEQUENCE 18 LOV: OK
STATE DURING RTL:
SEQ. 18

FOK18LOV

3.78E-04

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SEQUENCE 17 LOV: OK
STATE DURING RTL:
SEQ. 17

FOK17LOV

1.85E-04

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SEQUENCE 21 LOV: OK
STATE DURING RTL:
SEQ. 21

FOK21LOV

2.83E-06

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SEQUENCE 23 LOV: OK
STATE DURING RTL:
SEQ. 23

FOK23LOV

1.59E-08

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SEQUENCE 24 LOV: OK
STATE DURING RTL:
SEQ. 24

FOK24LOV

4.82E-08

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STATE DURING RTL:
SEQ. 28

FOK28LOV

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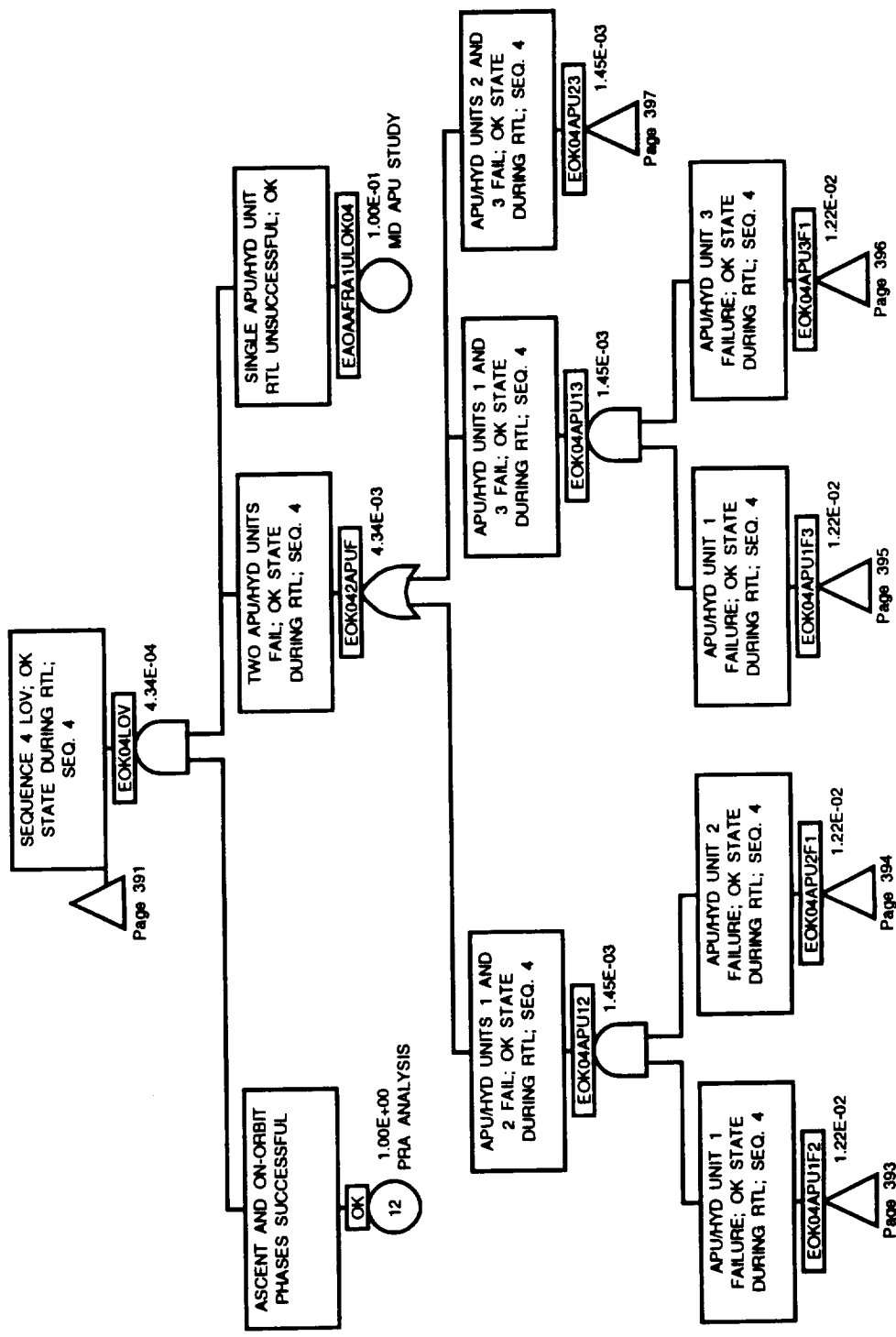
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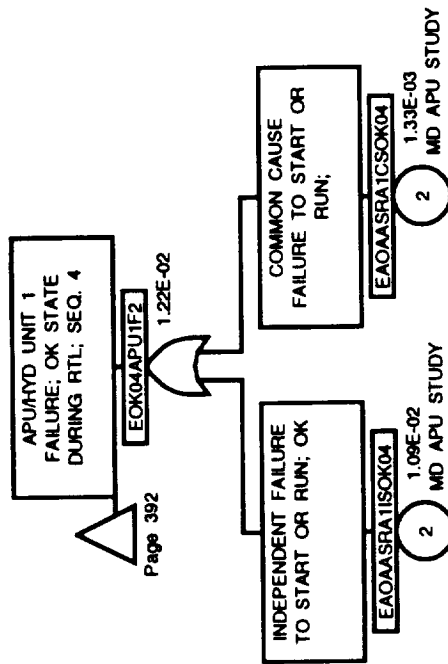
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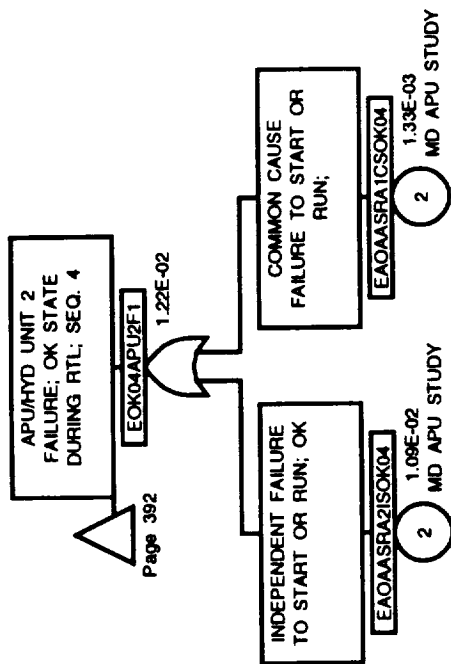
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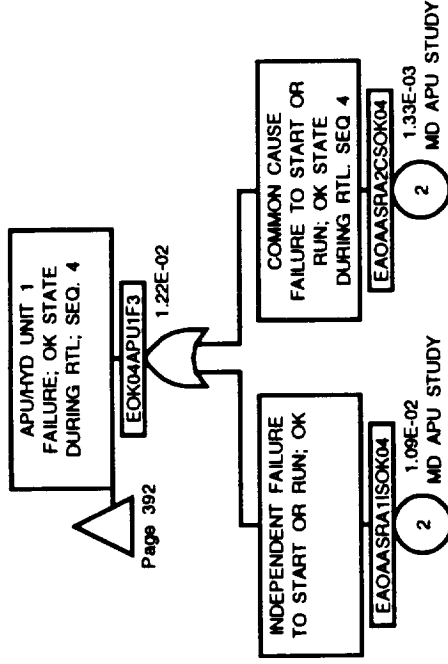




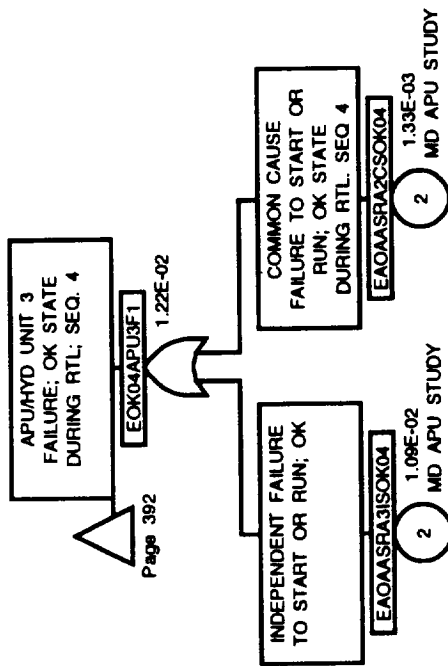
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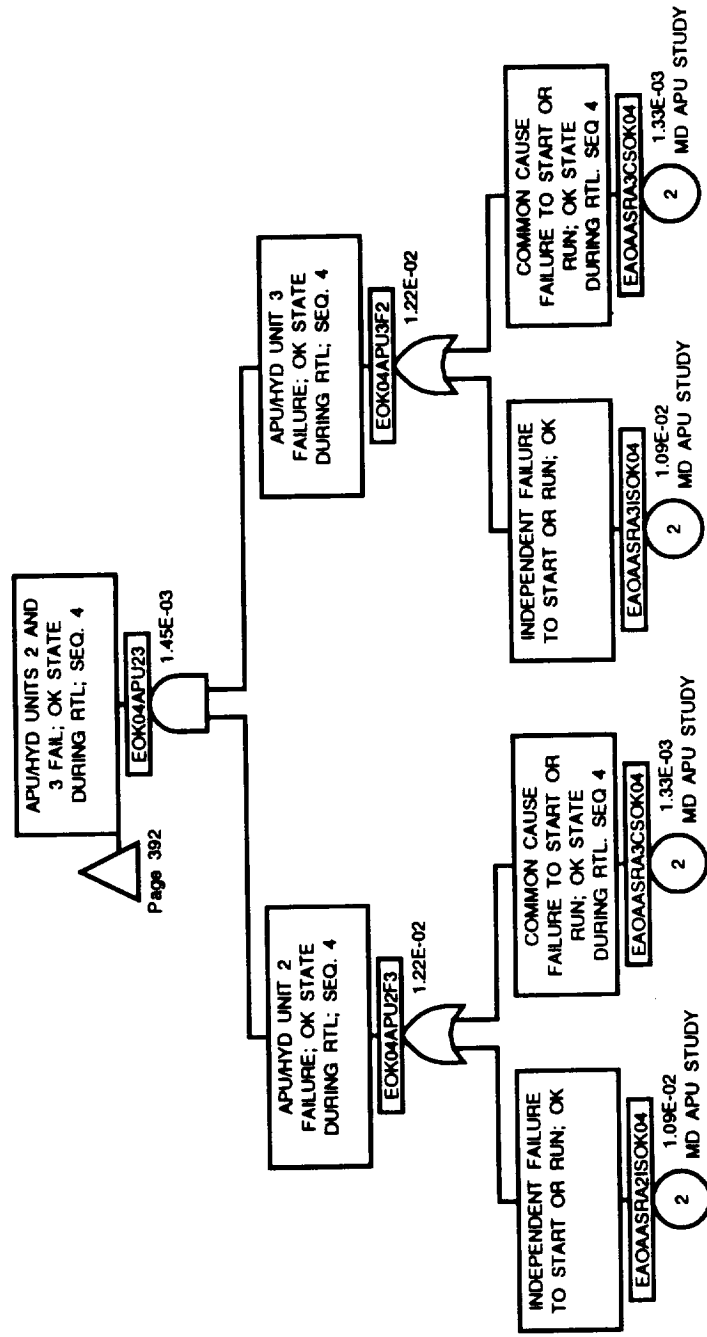
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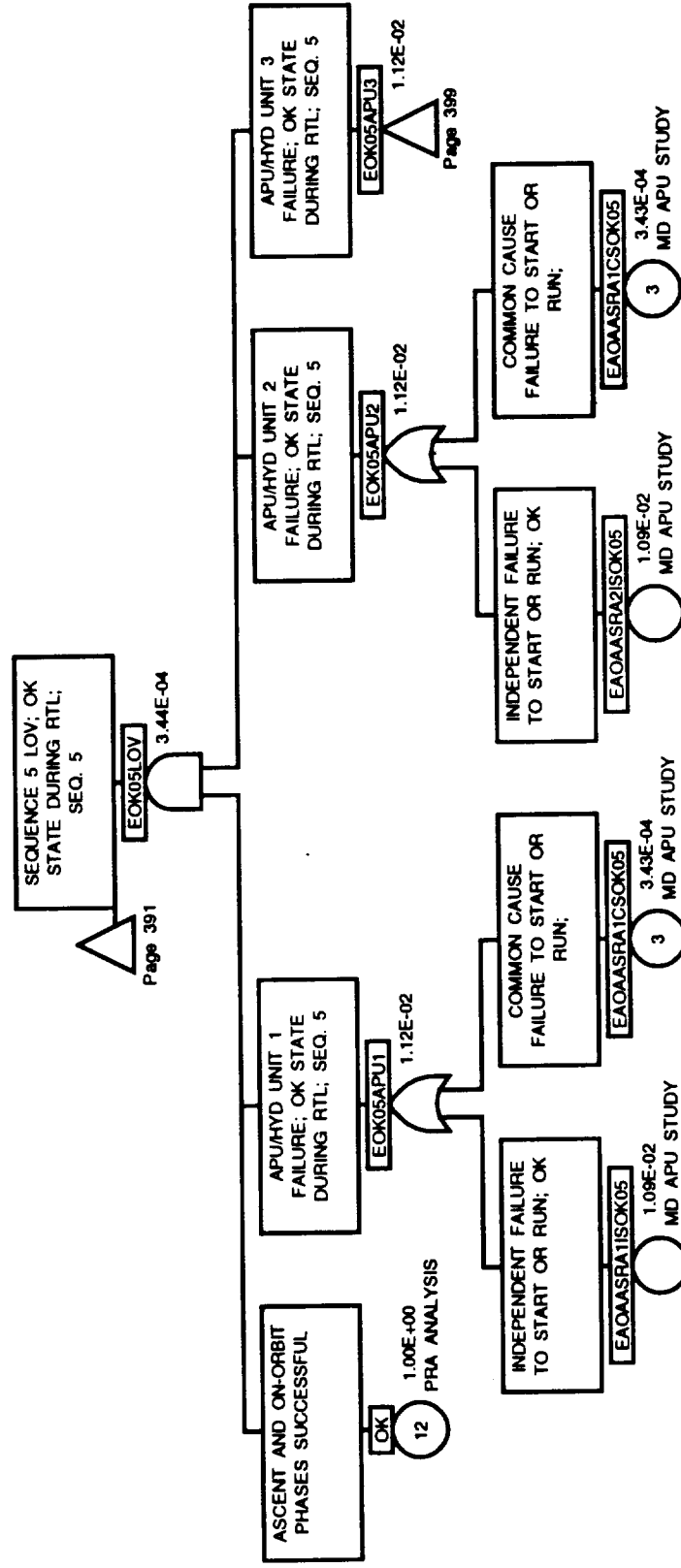


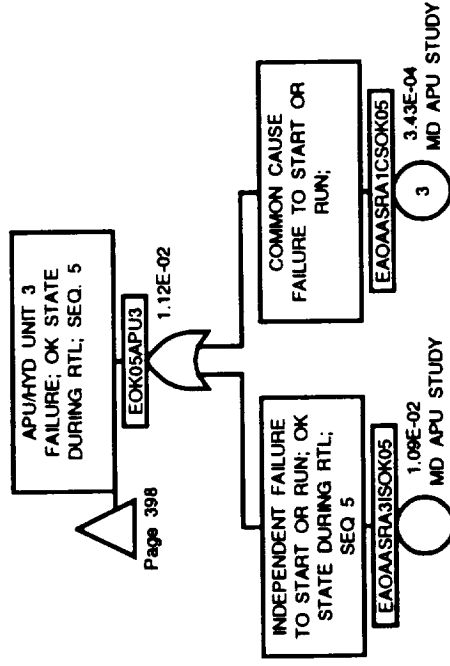
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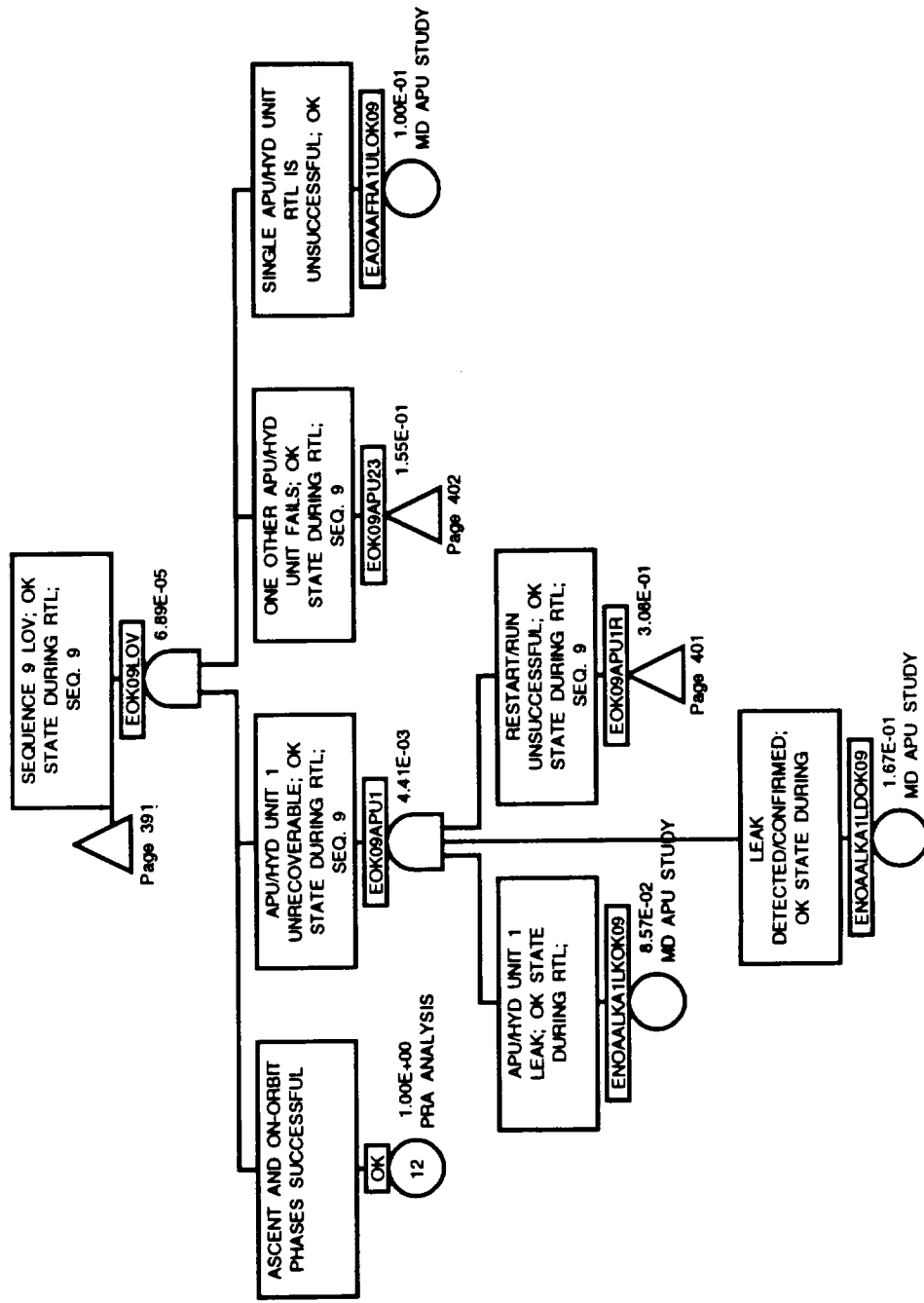
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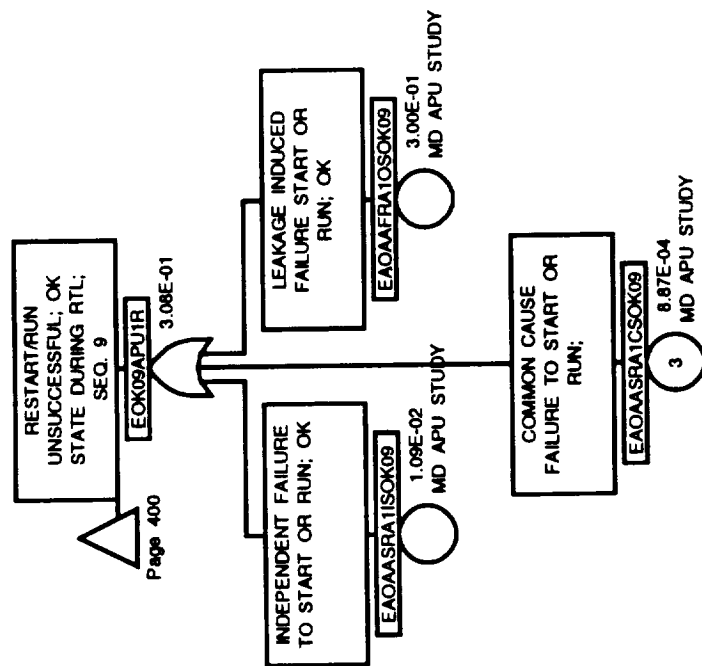




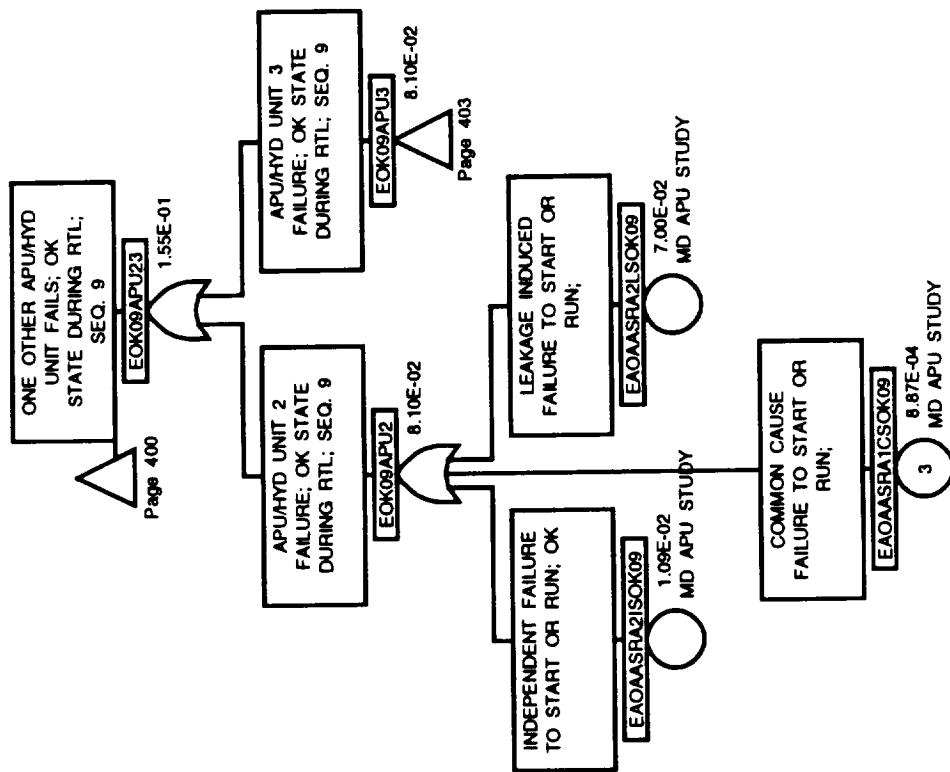


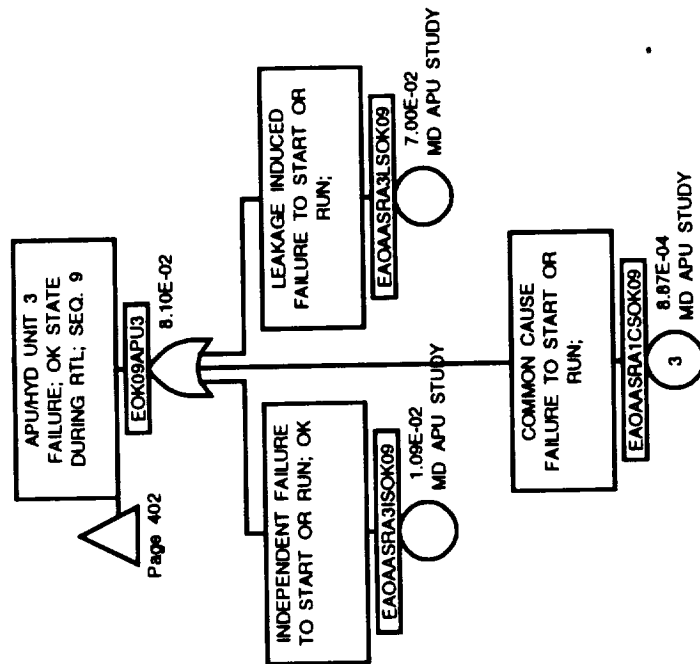
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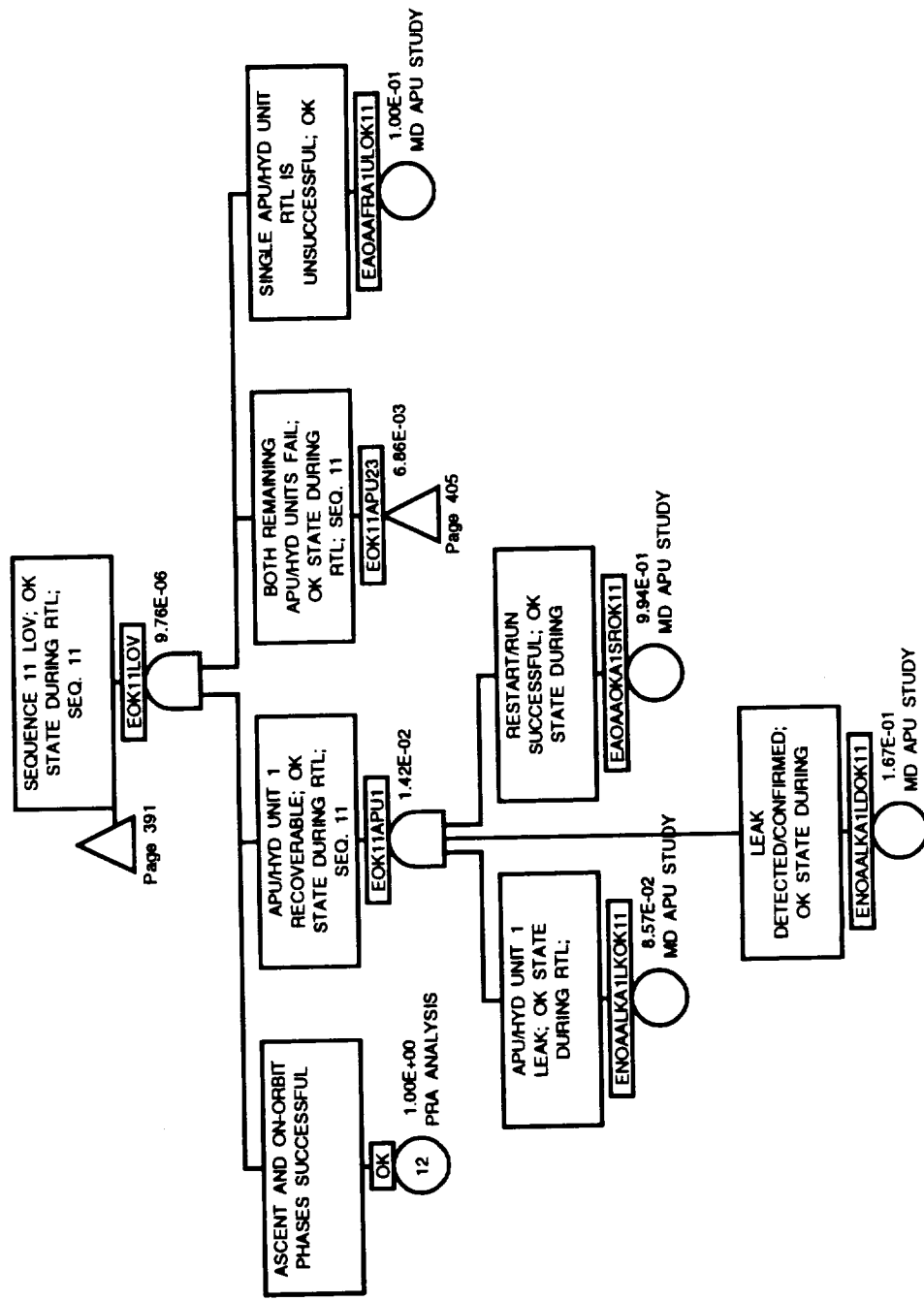


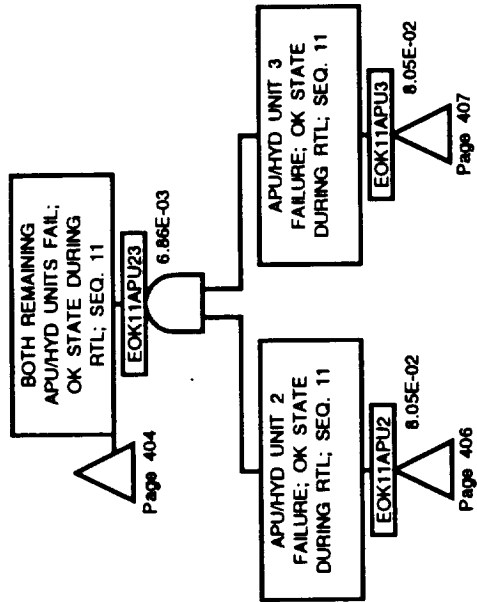
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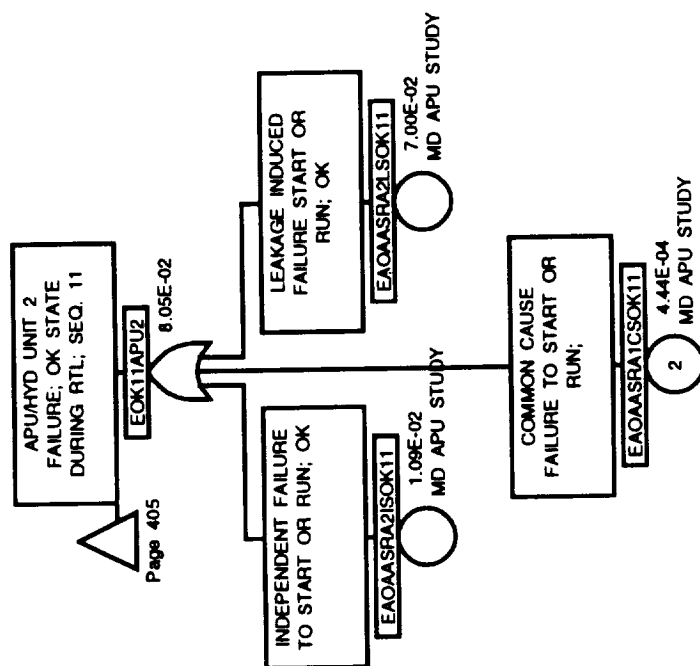




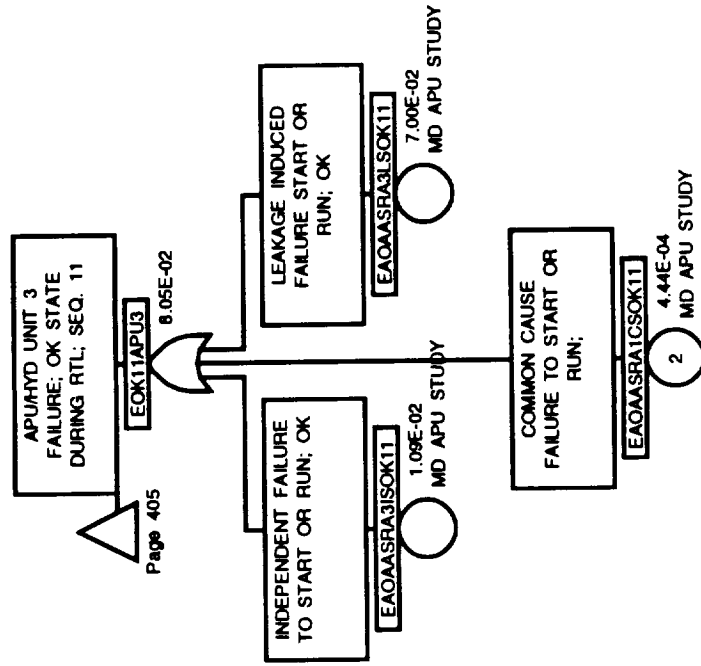
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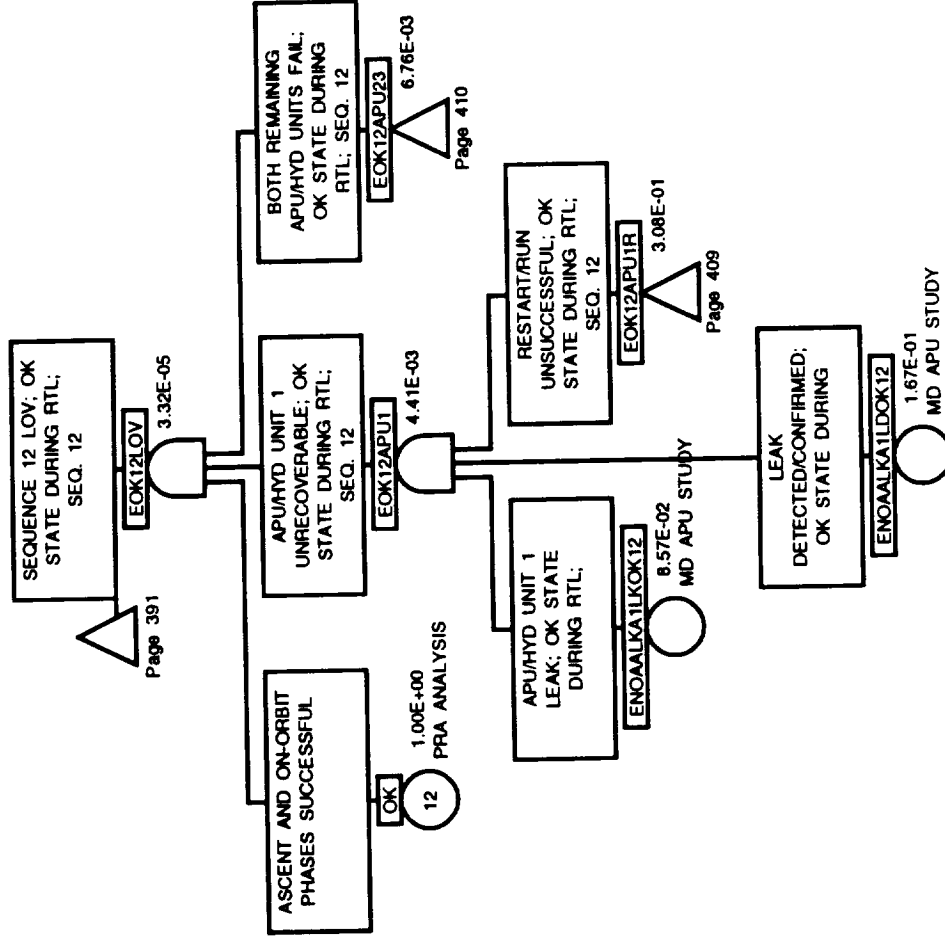


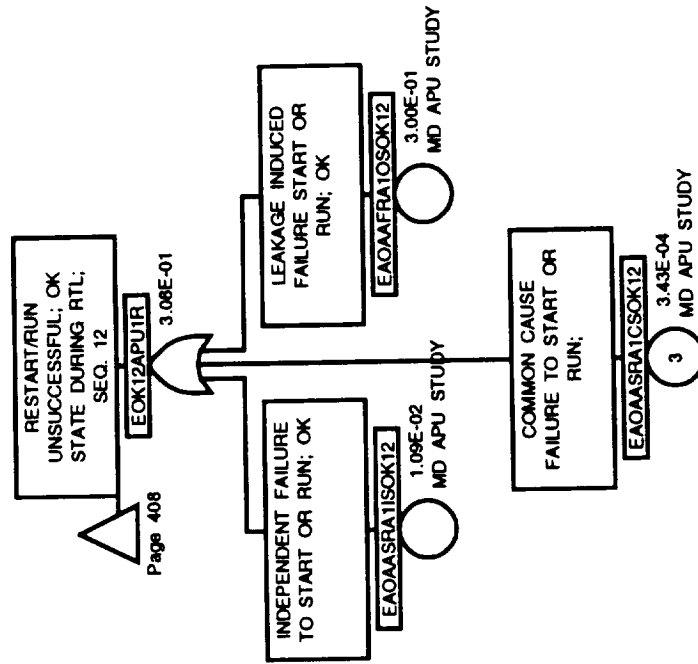




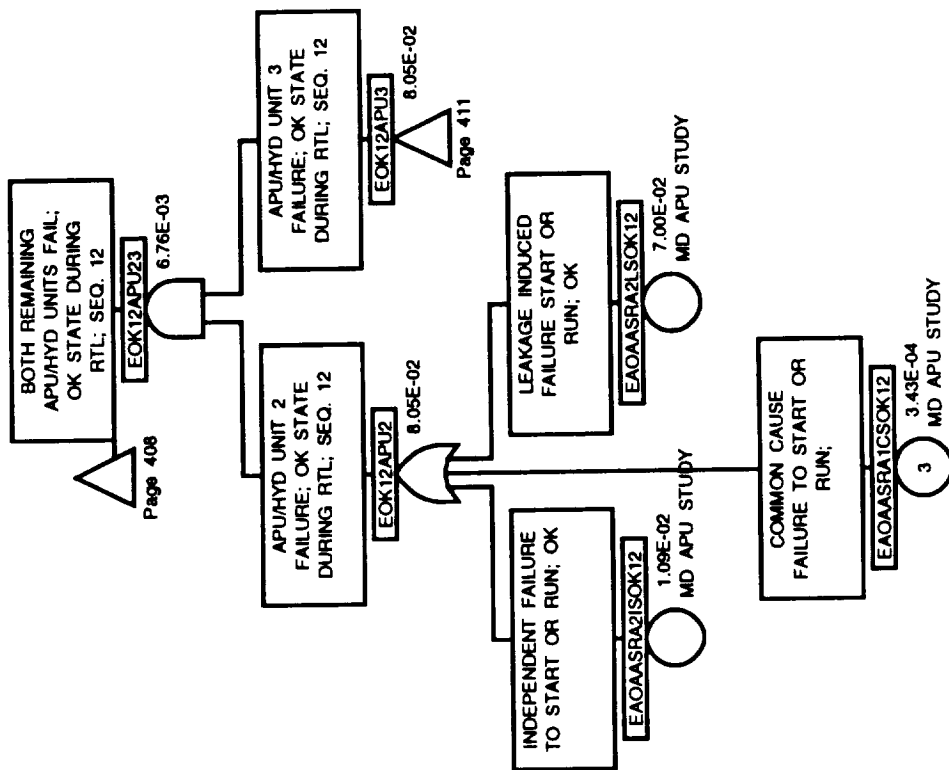
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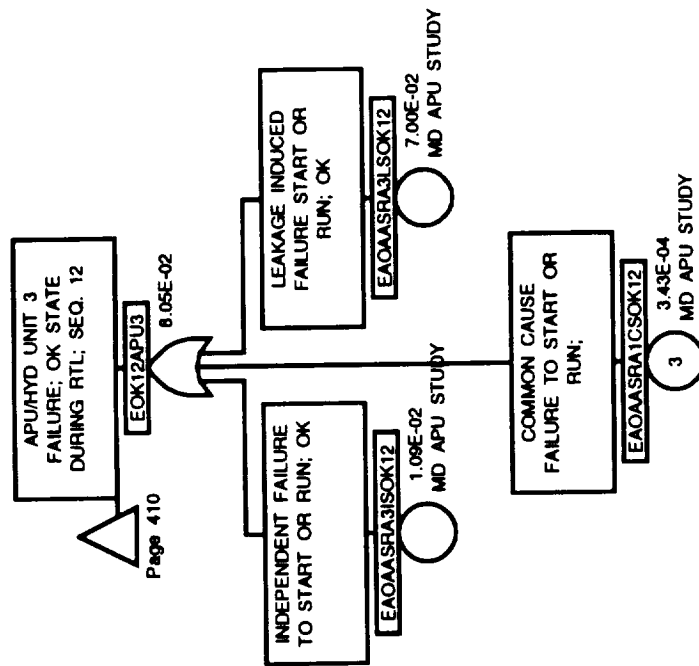




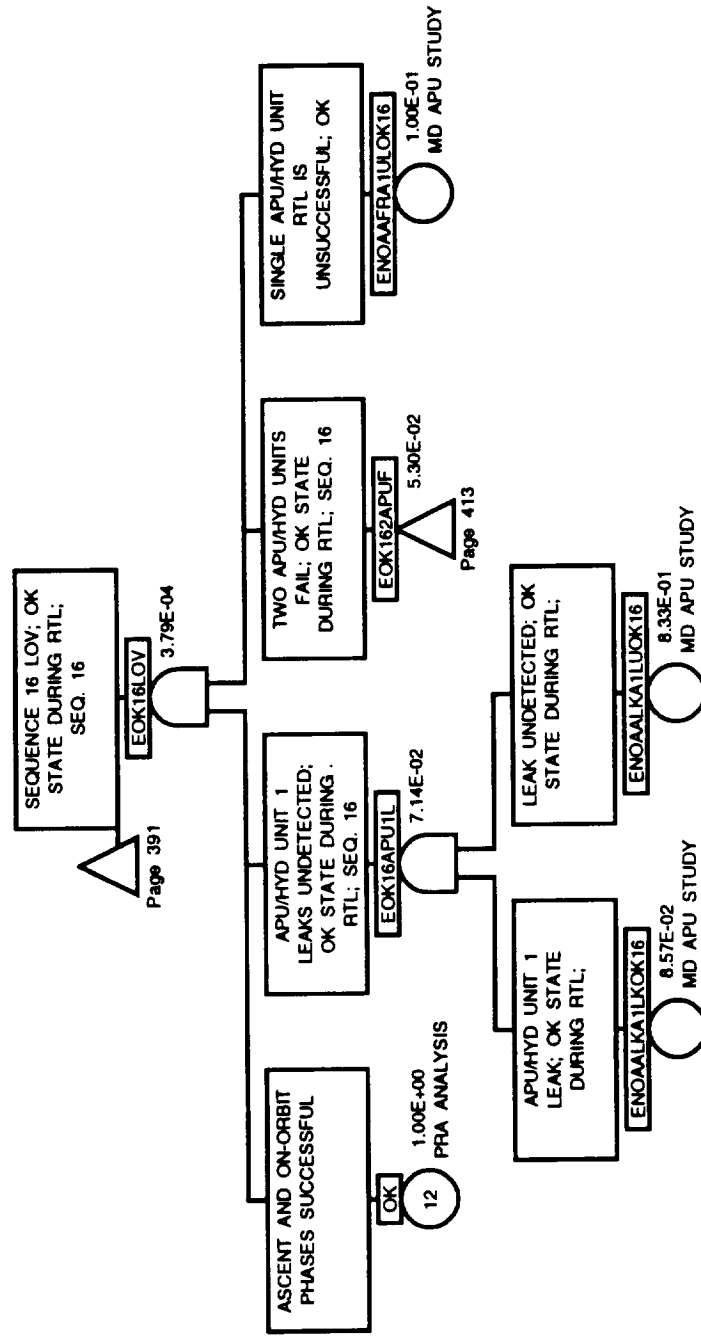


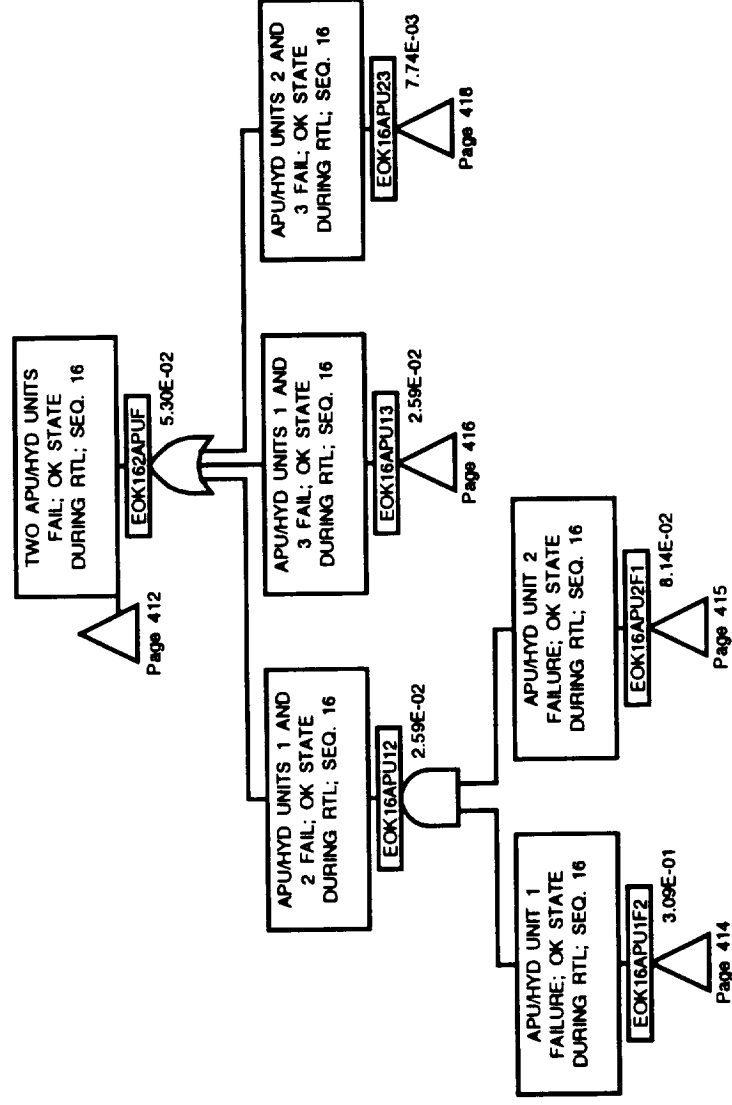
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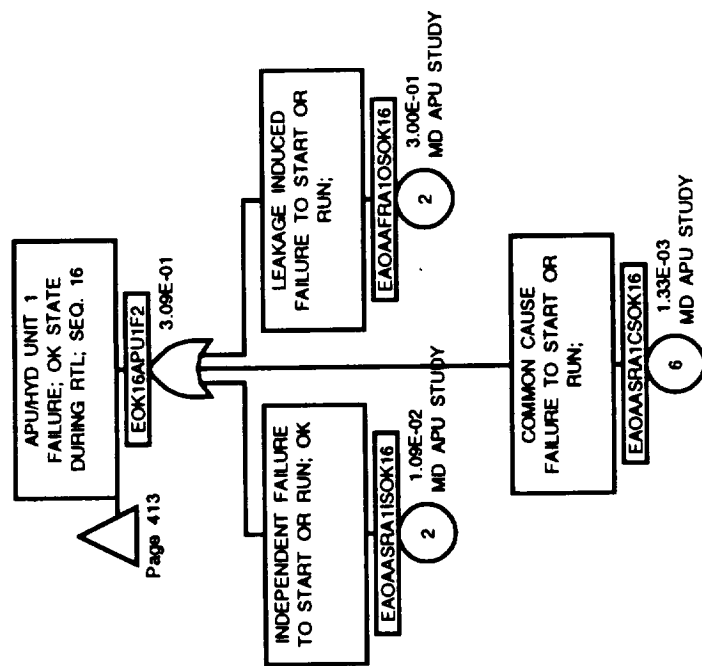


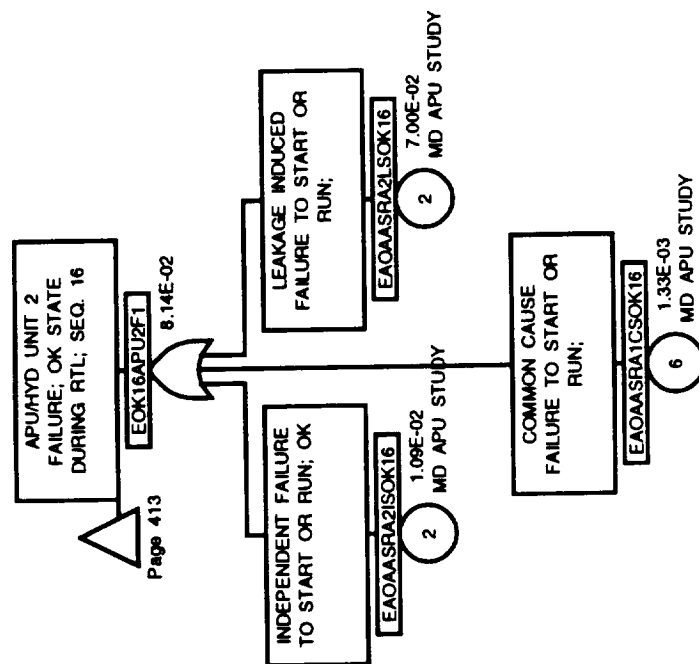


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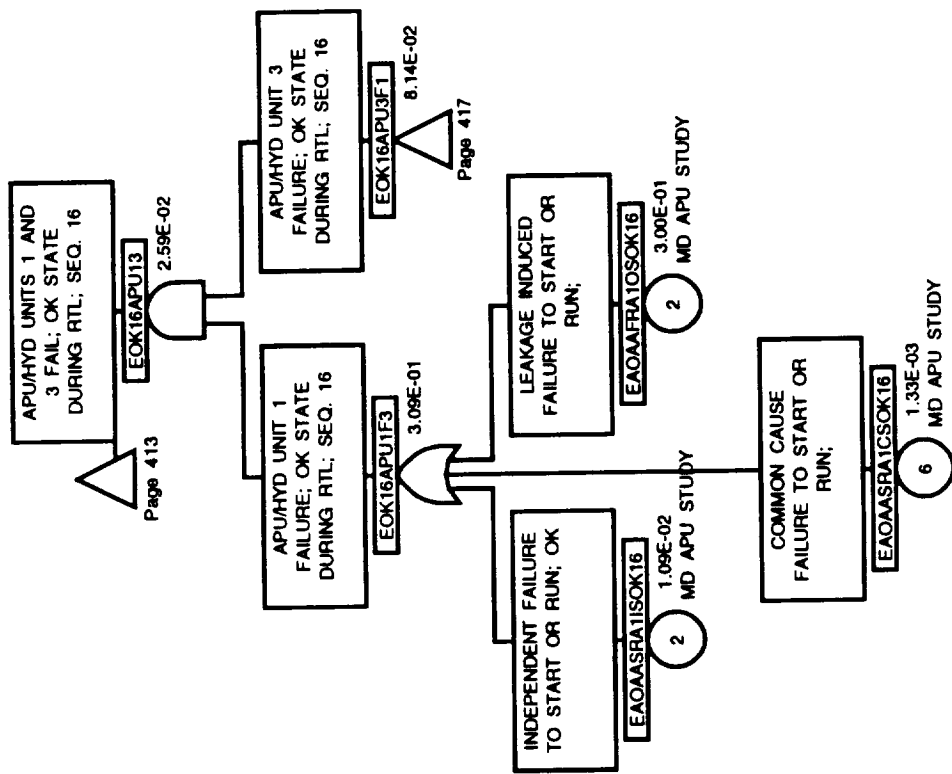


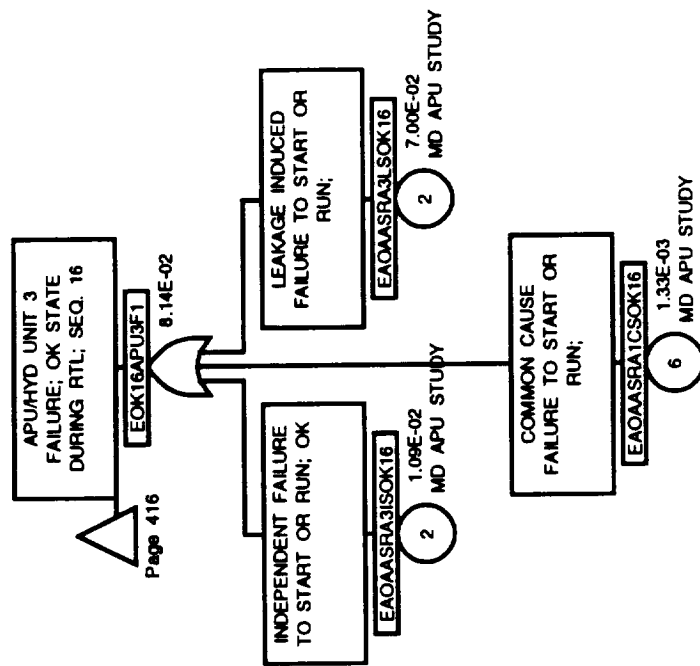


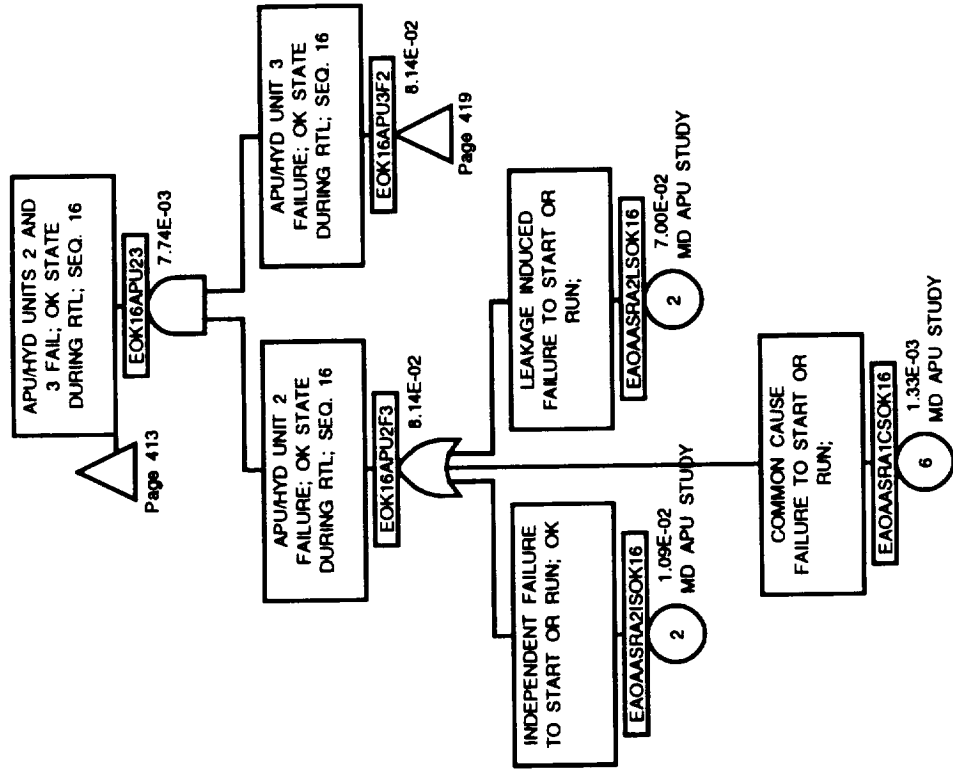


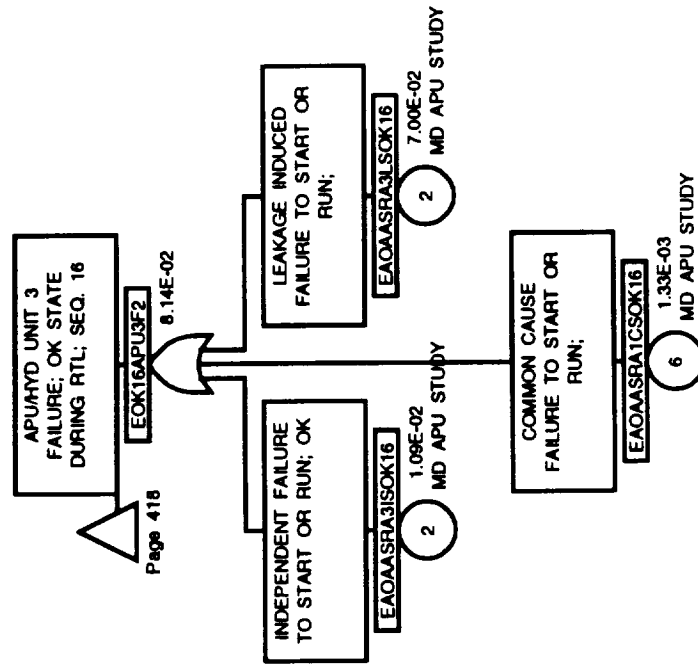


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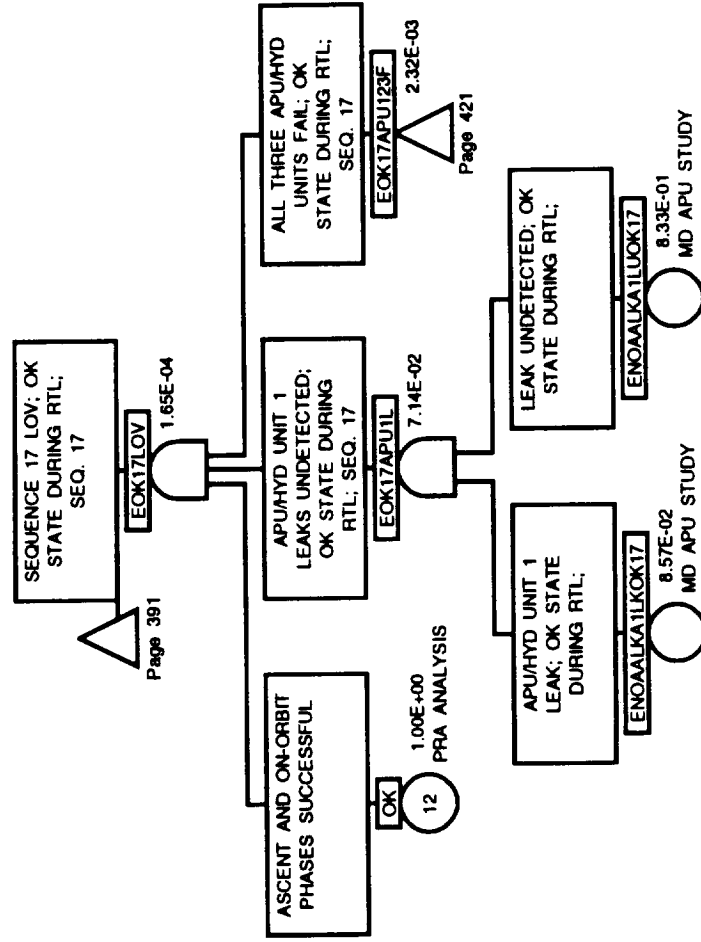


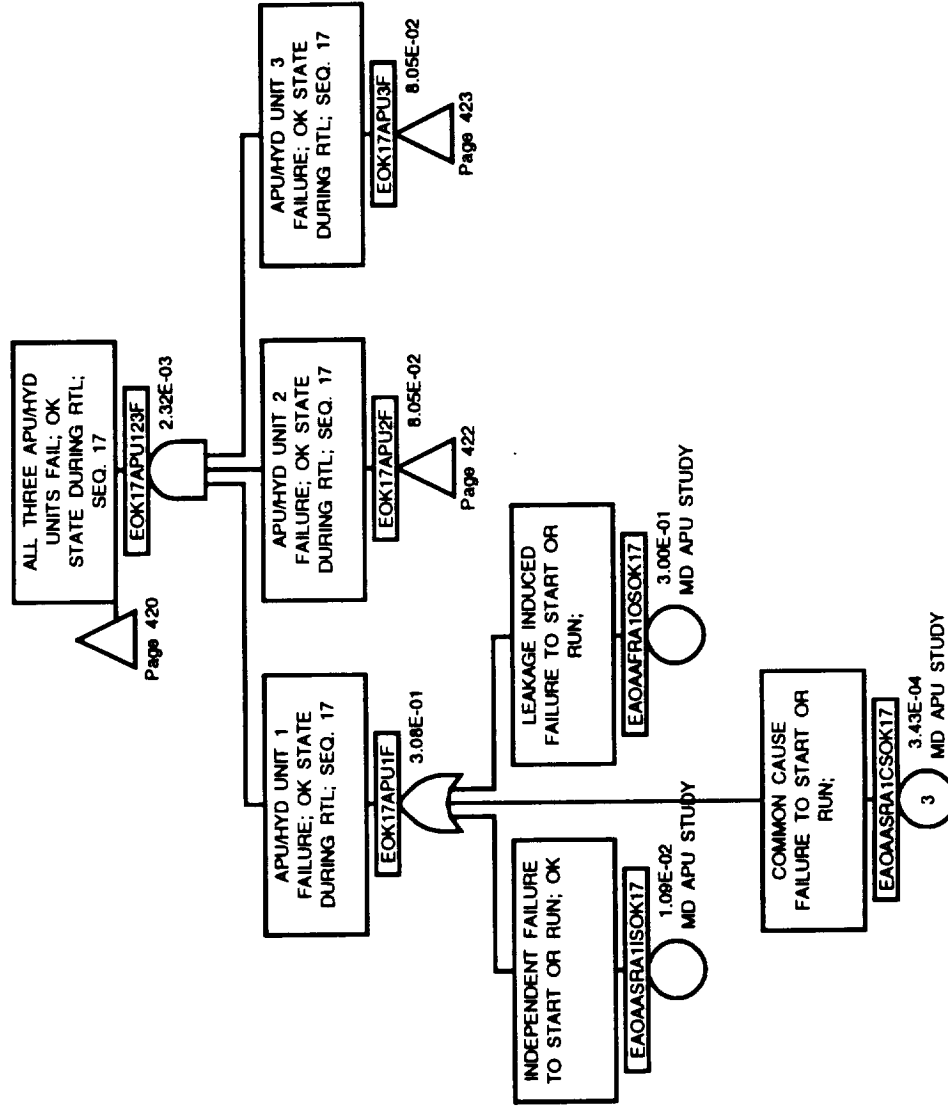


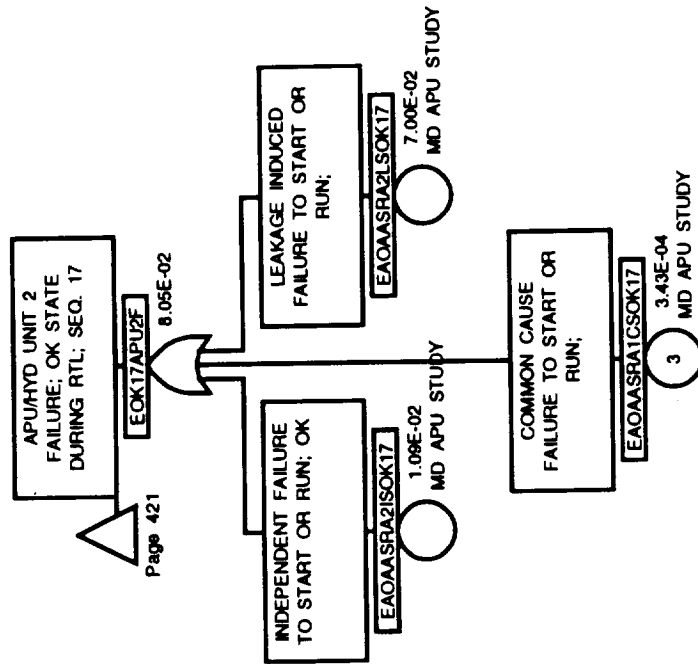




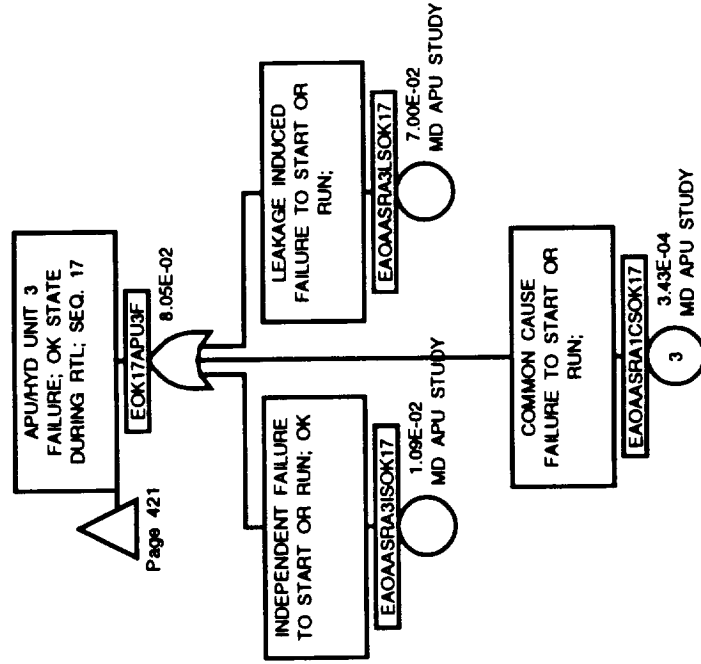
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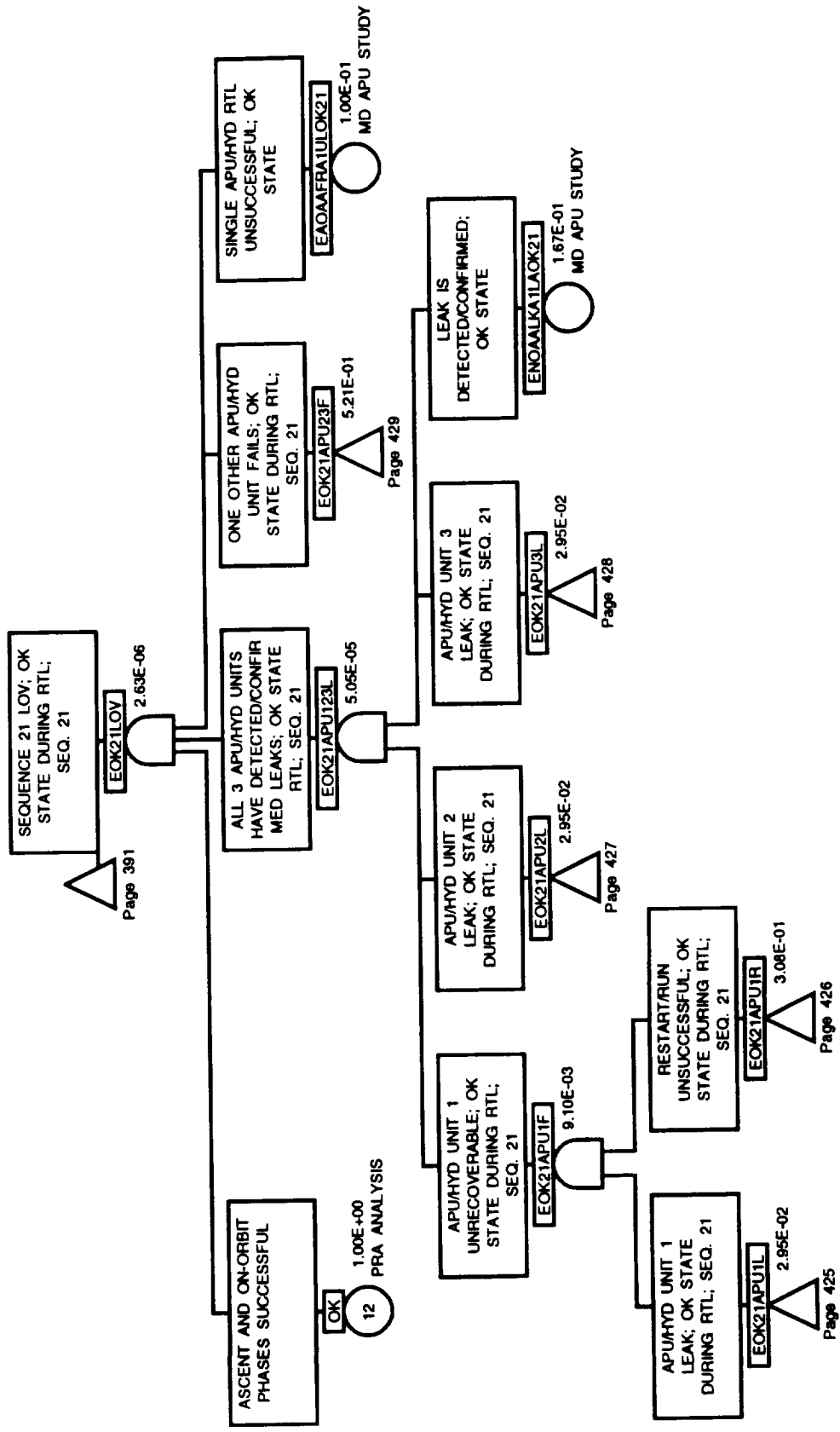


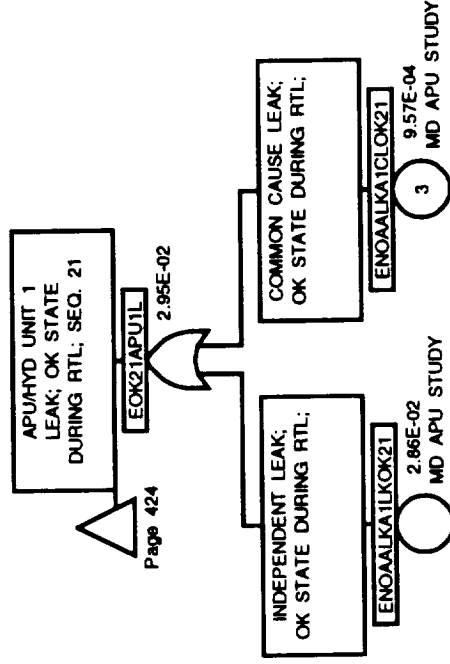


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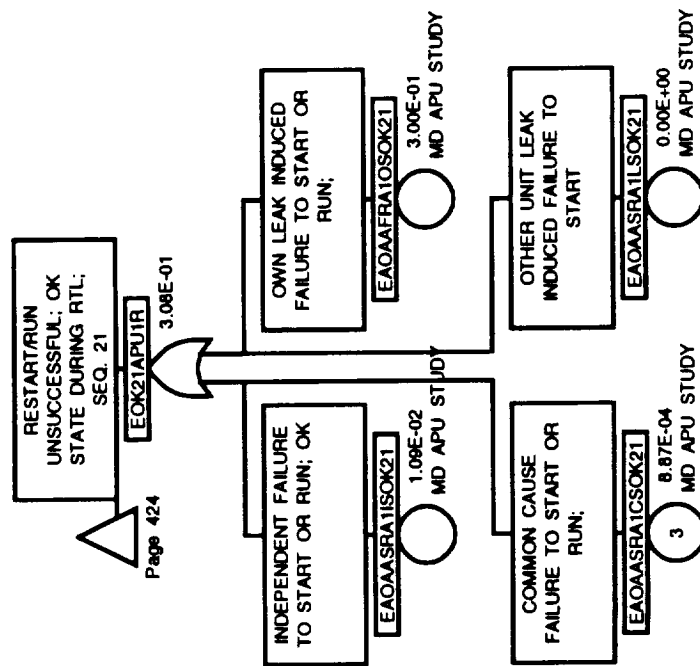


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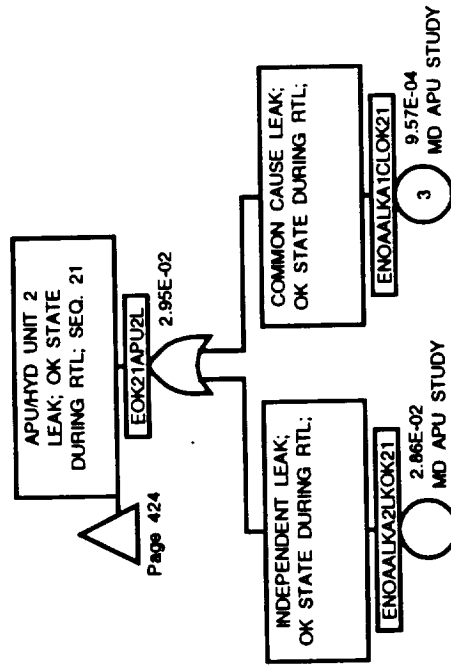


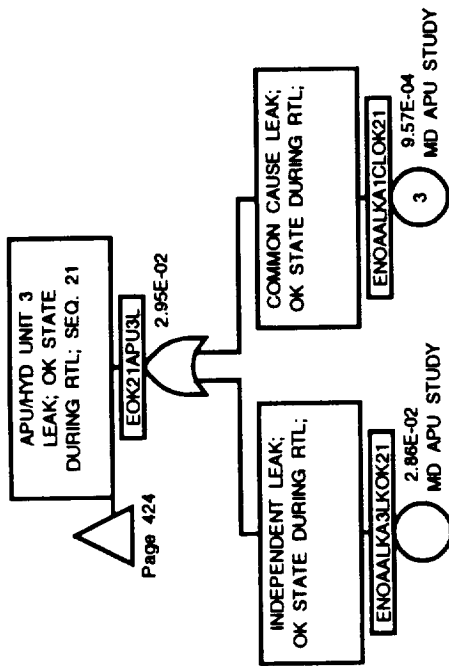


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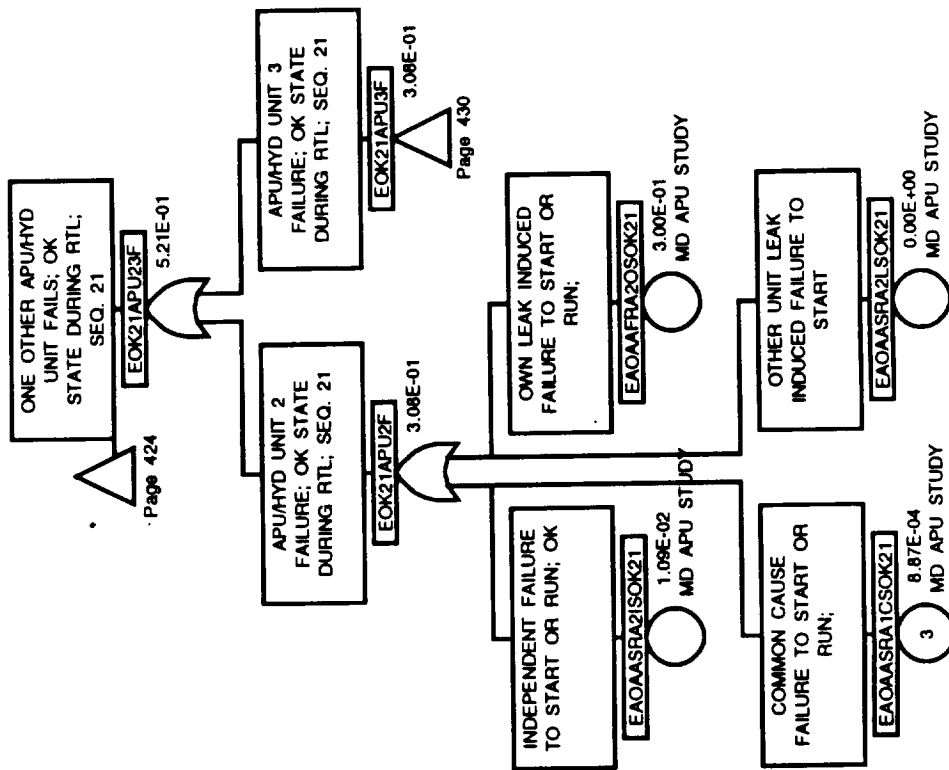


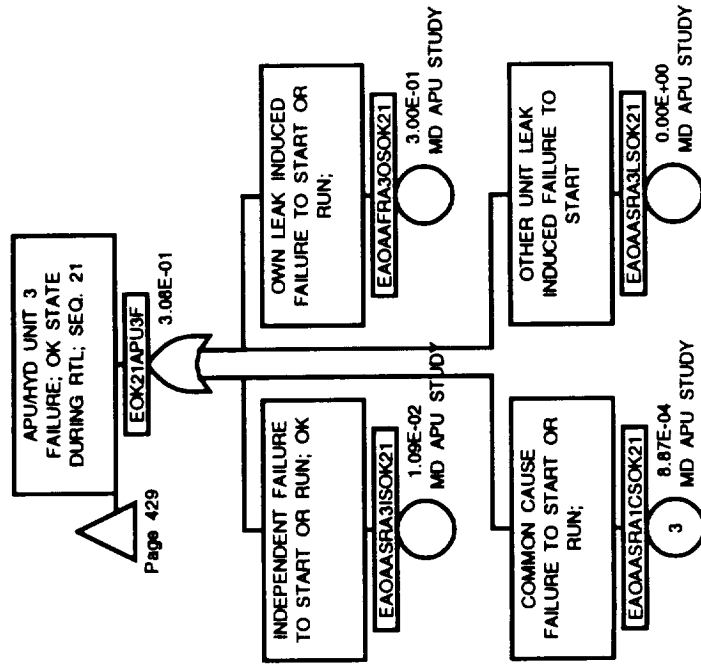
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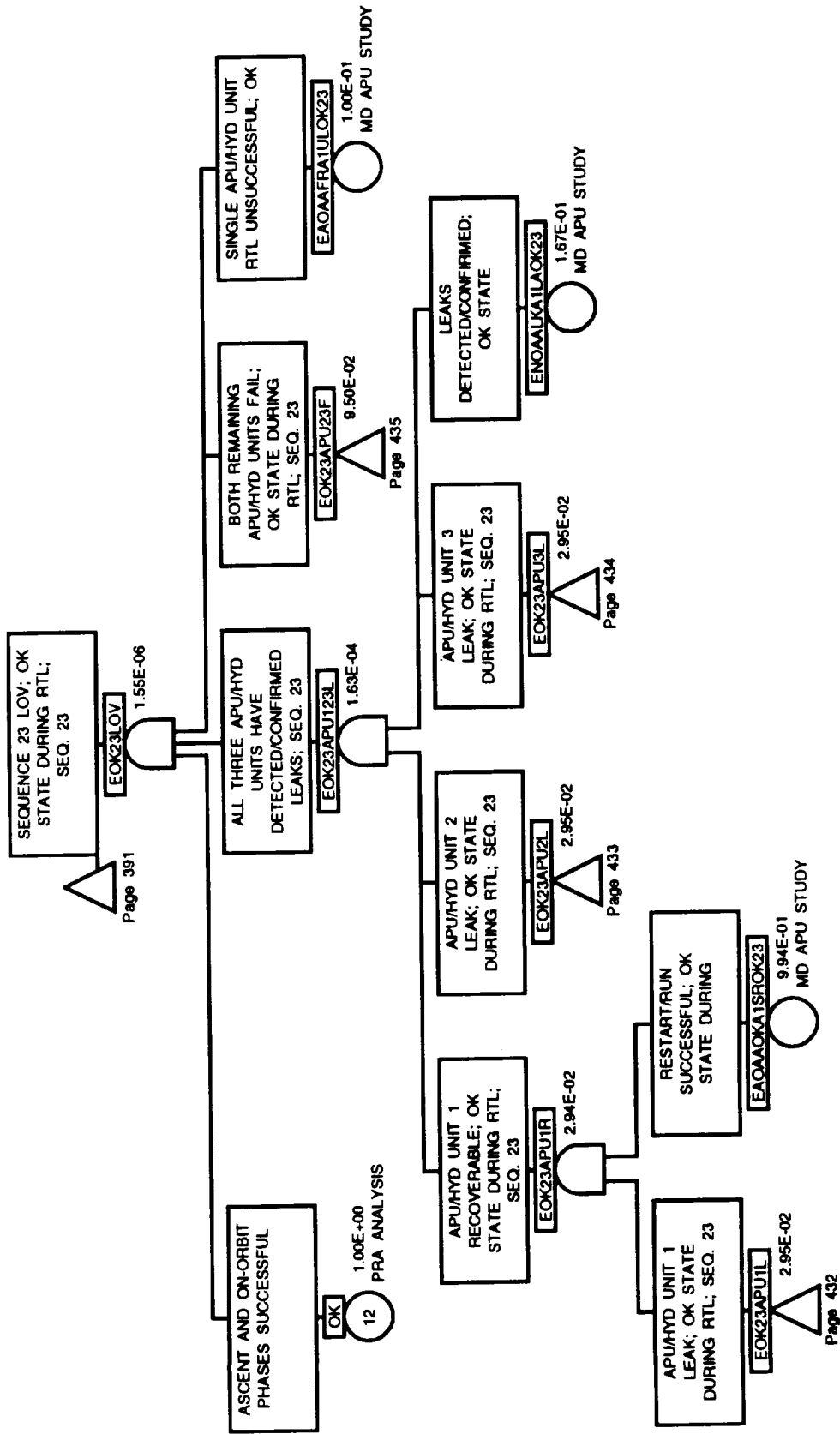


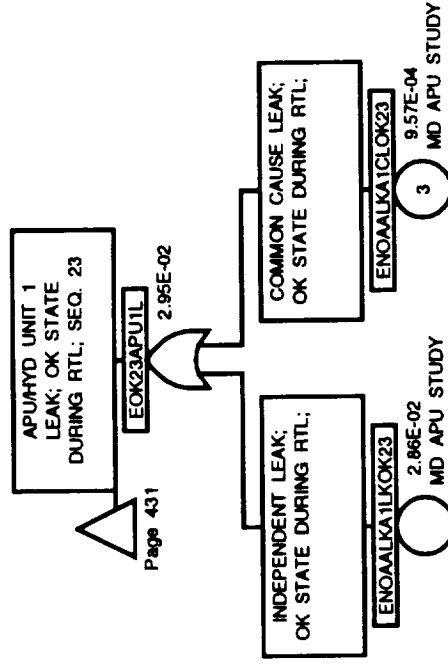
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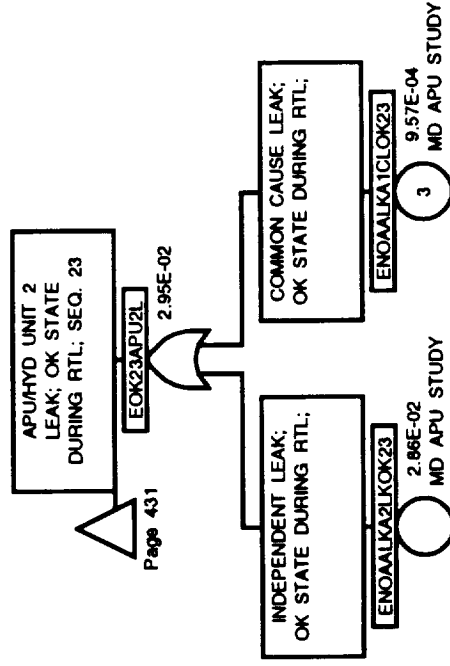


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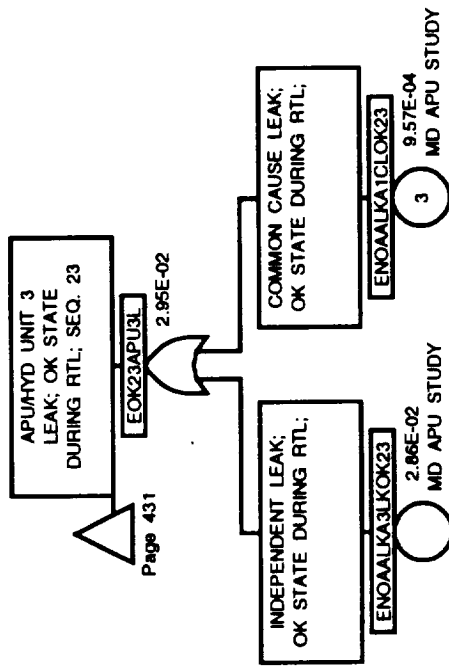


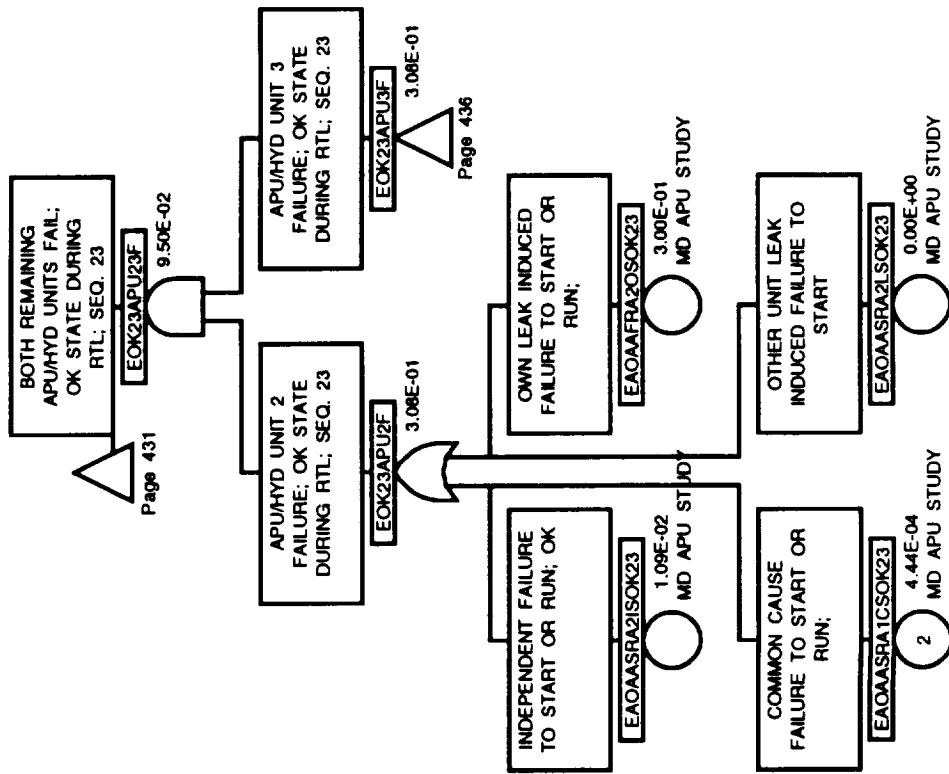


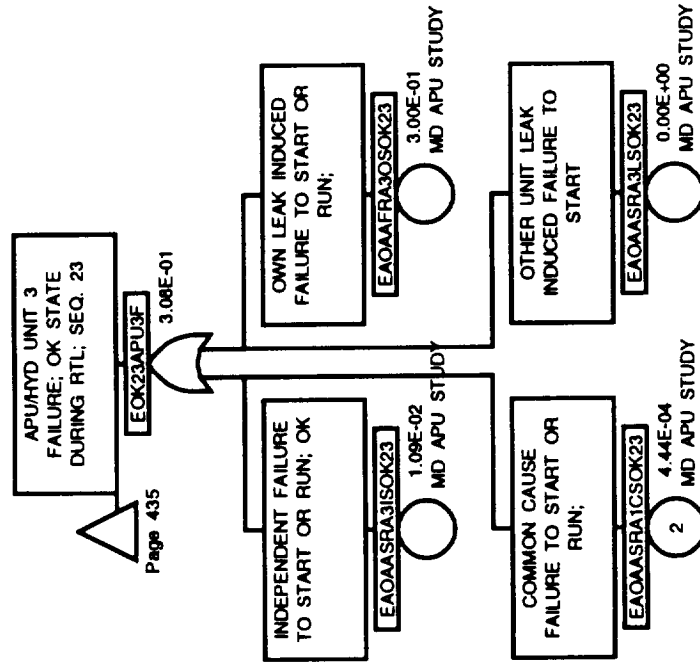
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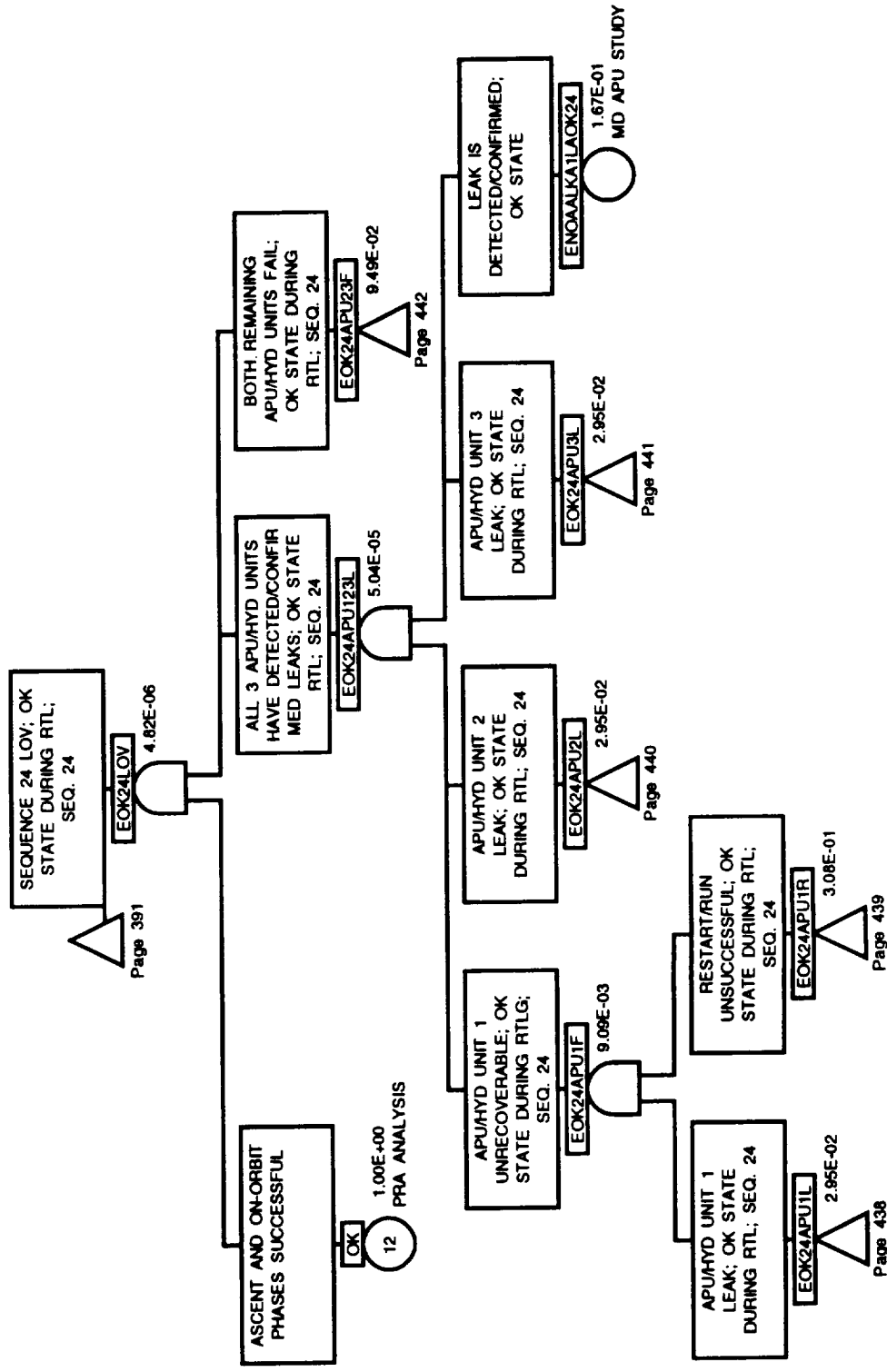
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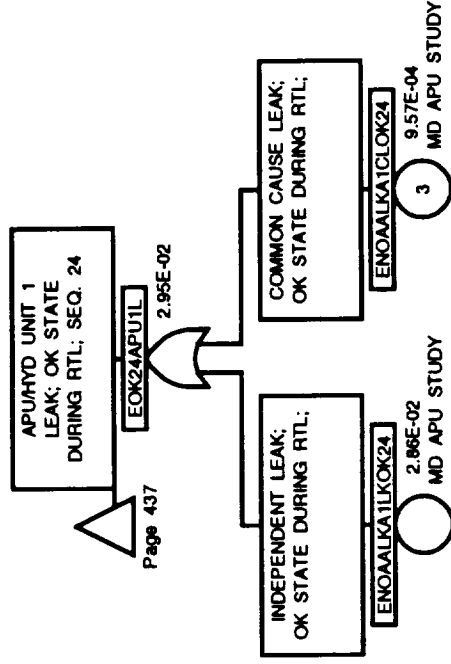


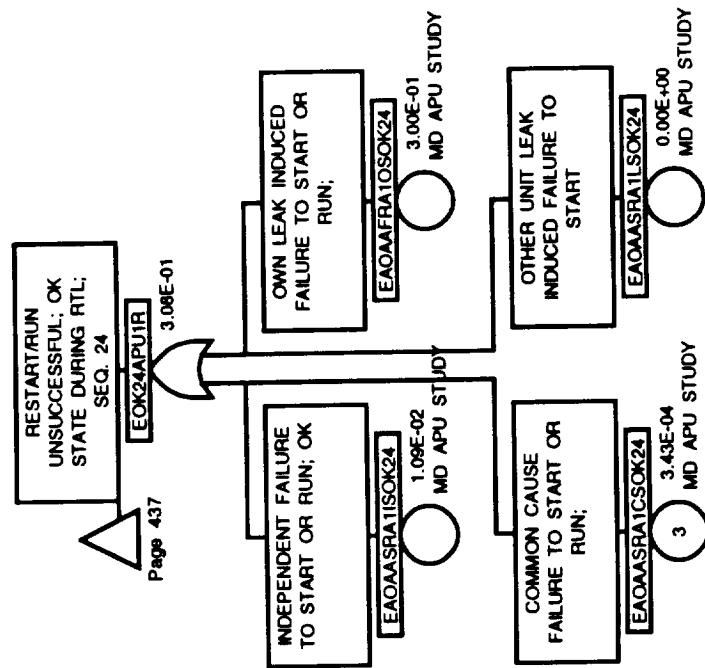


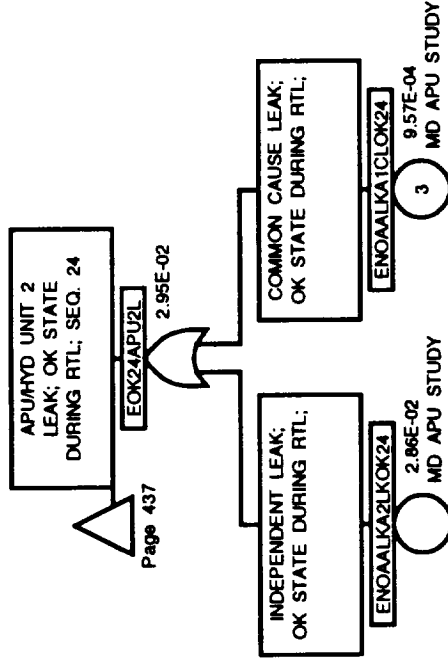


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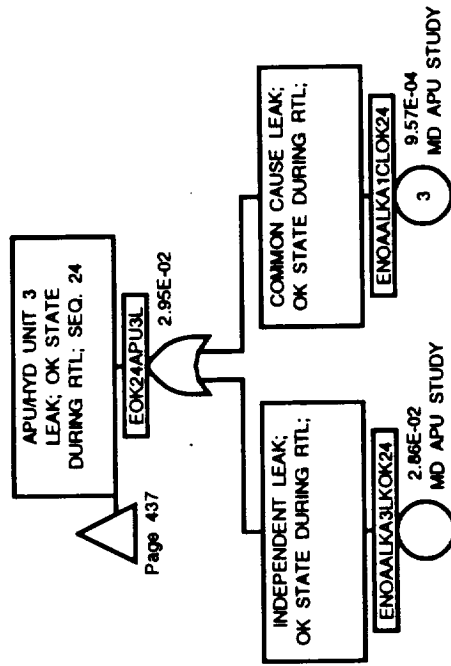




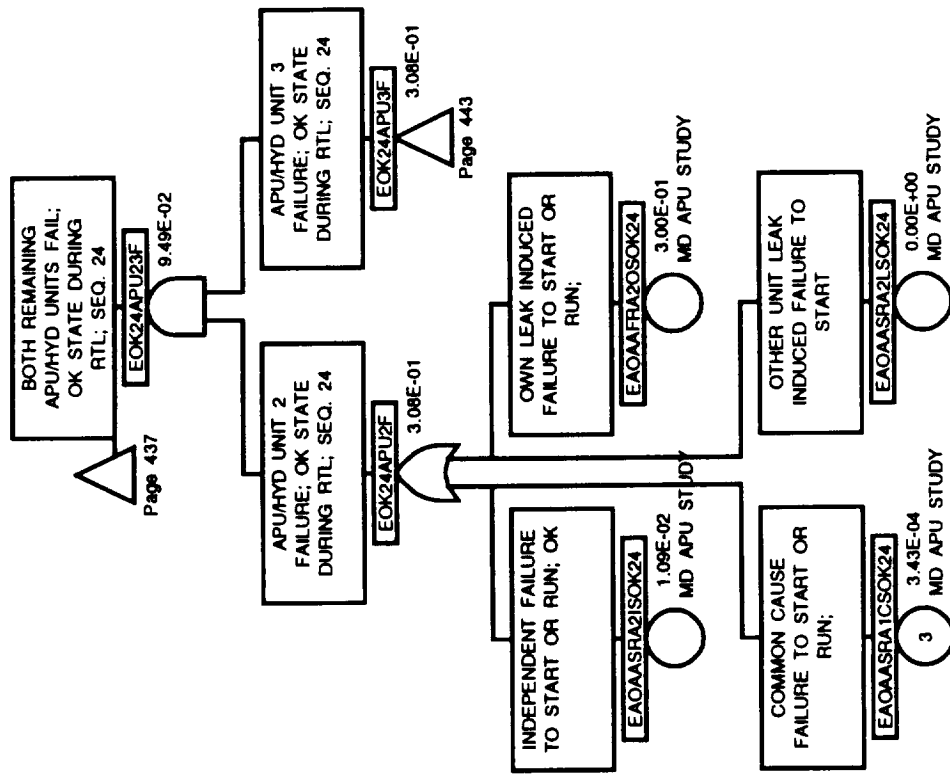


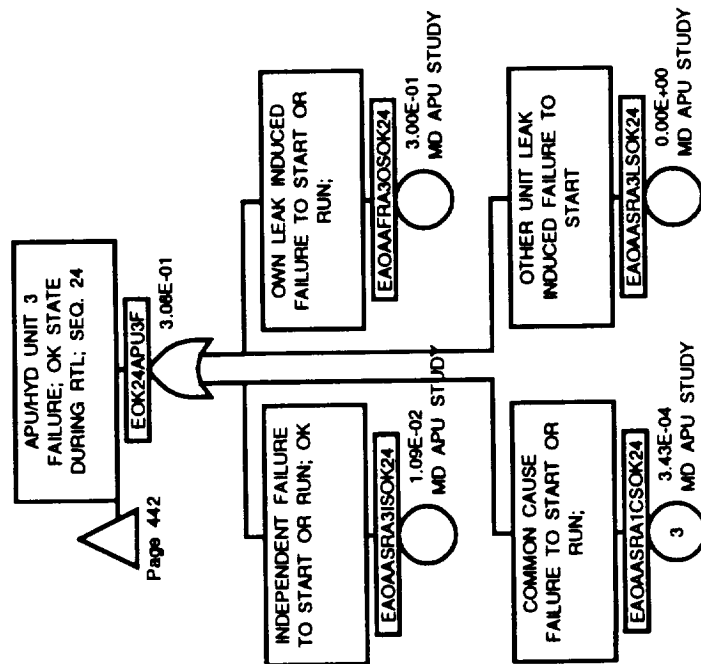


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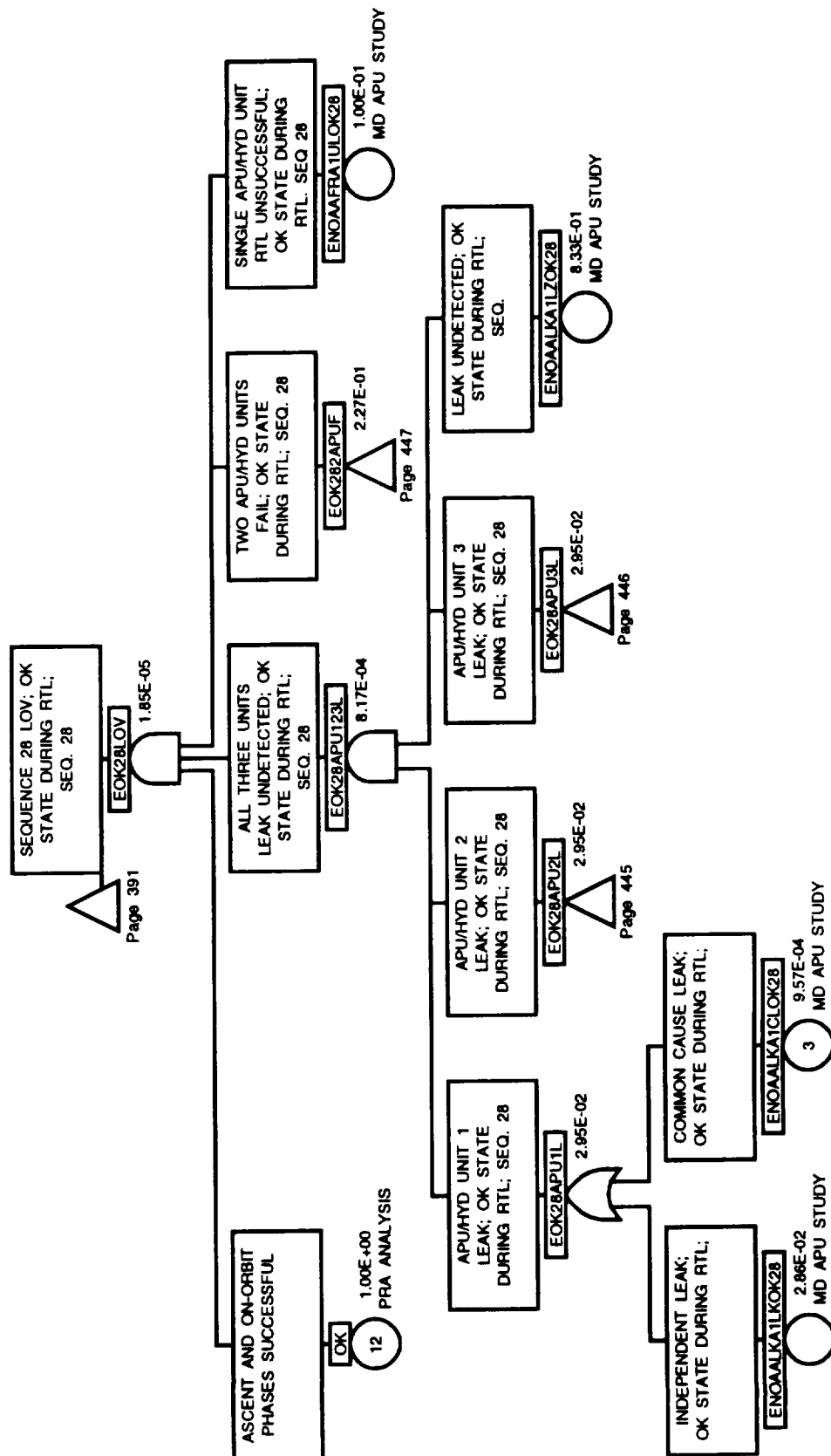


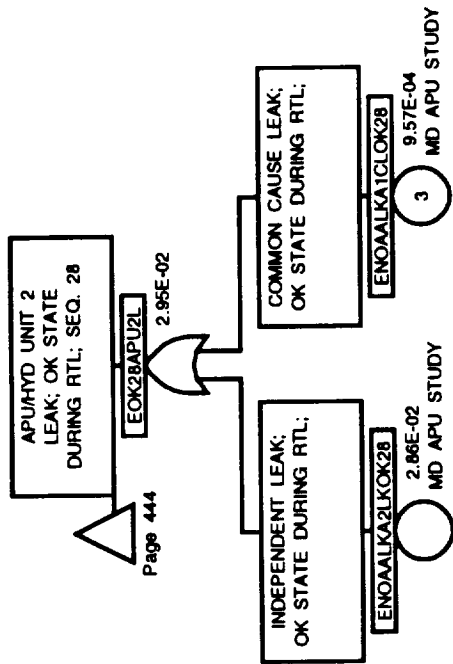
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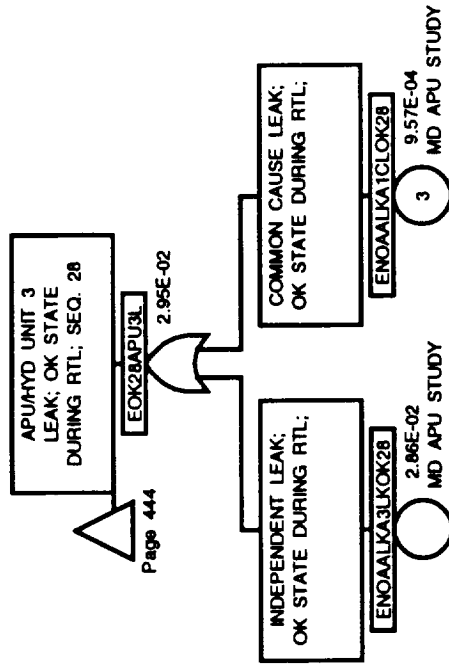


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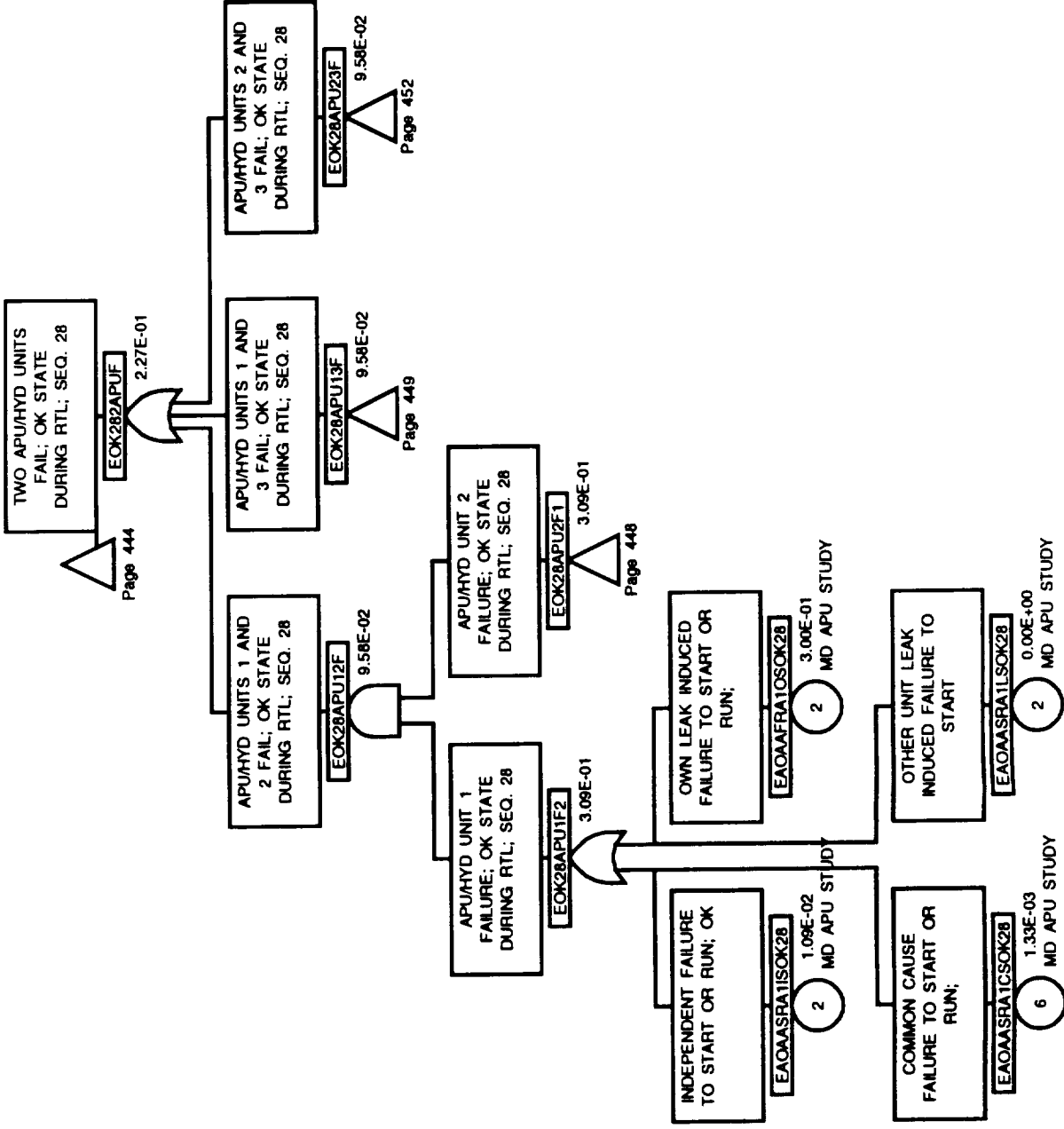


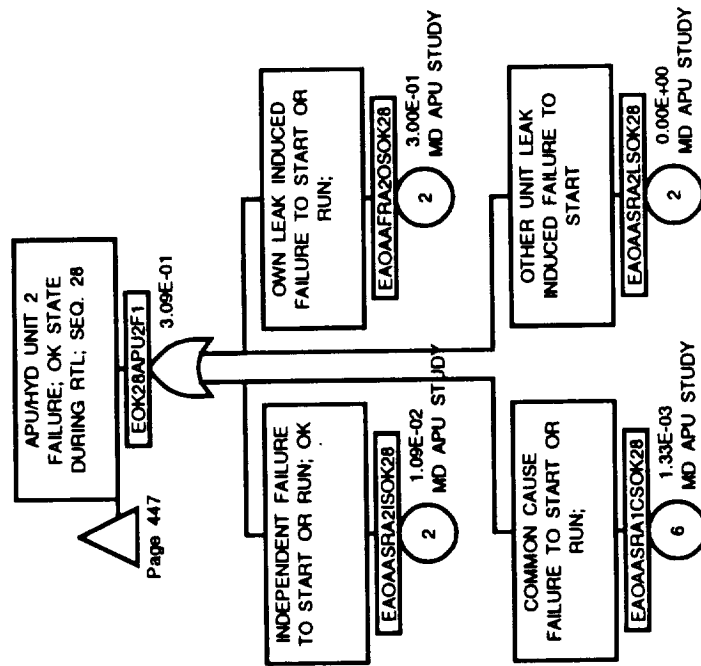


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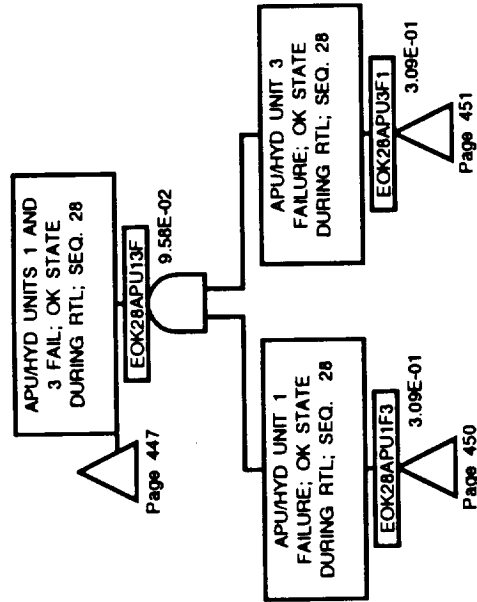


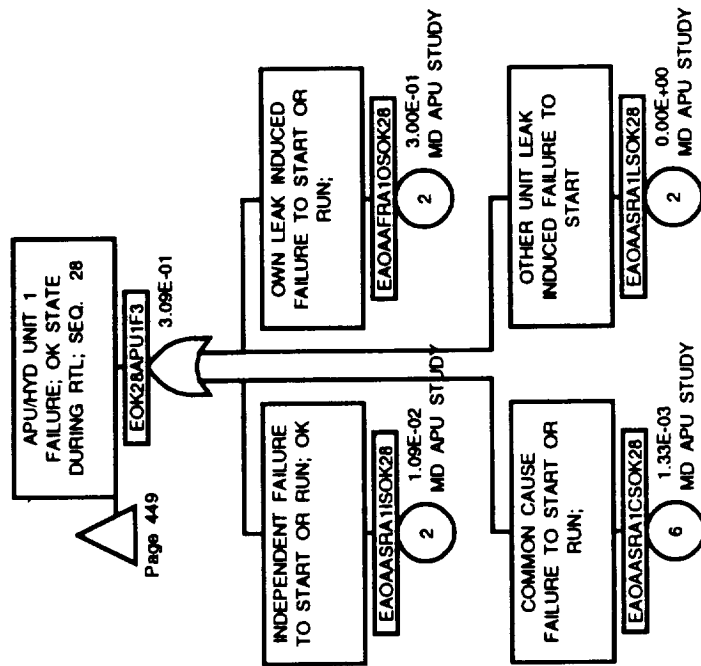
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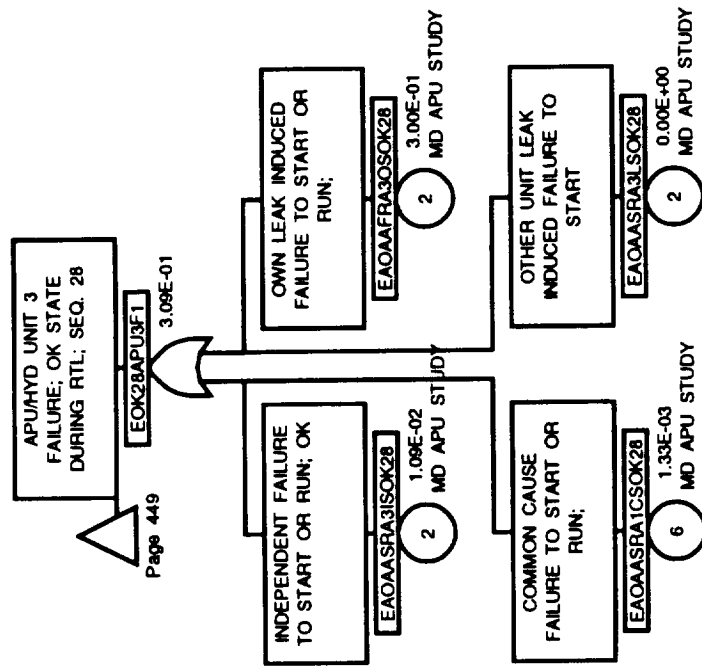


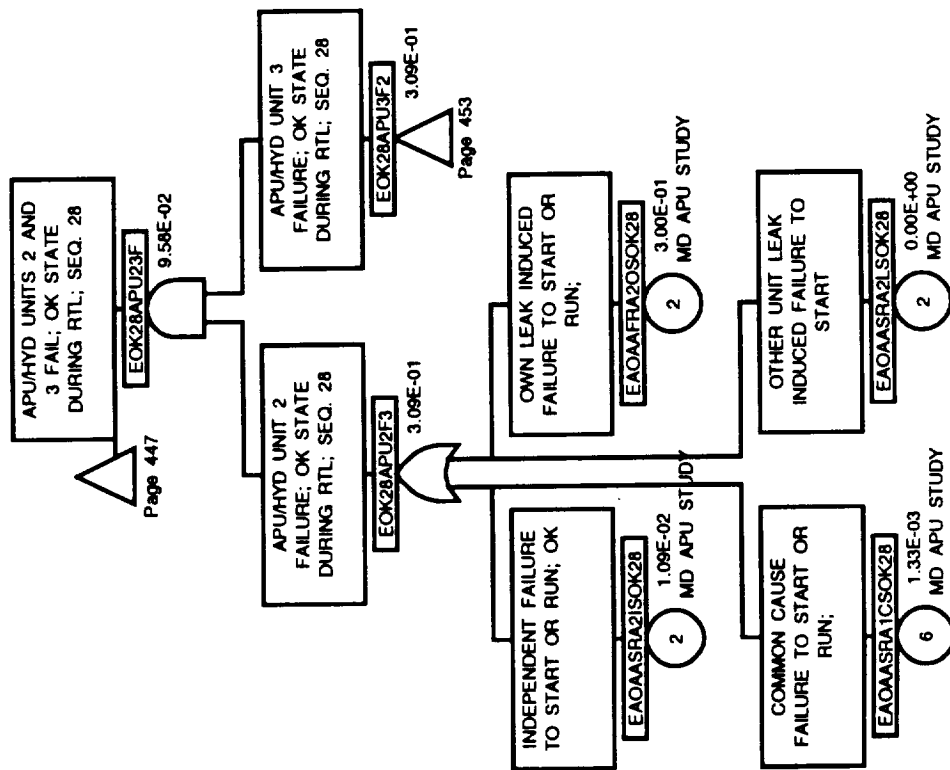
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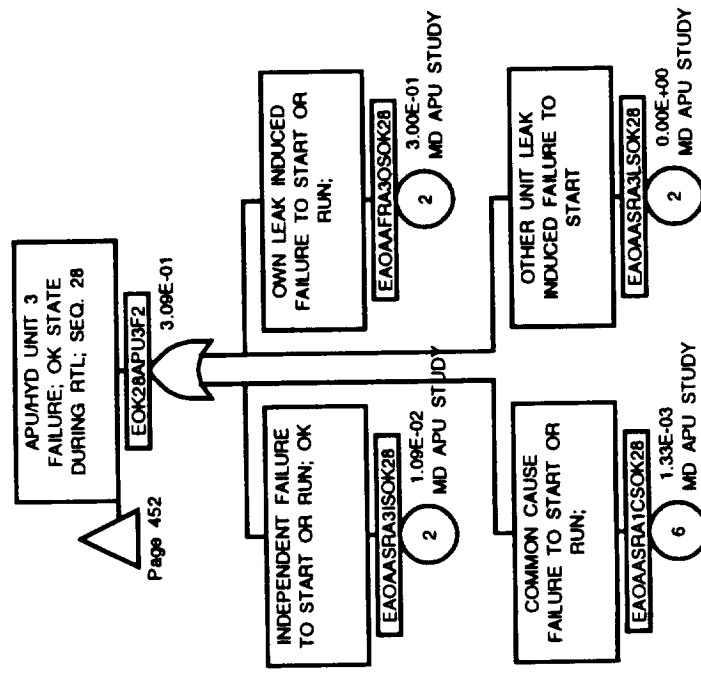




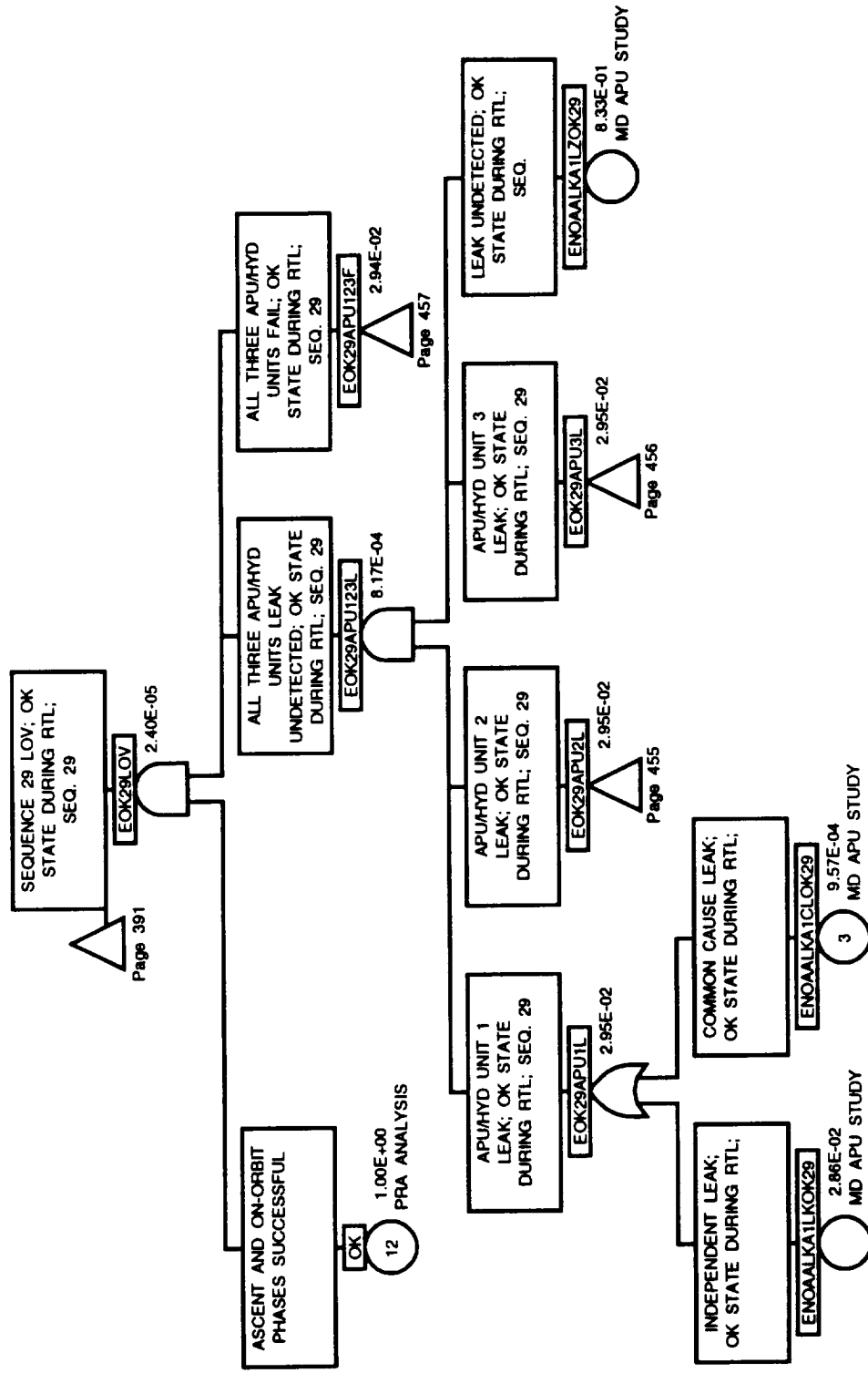
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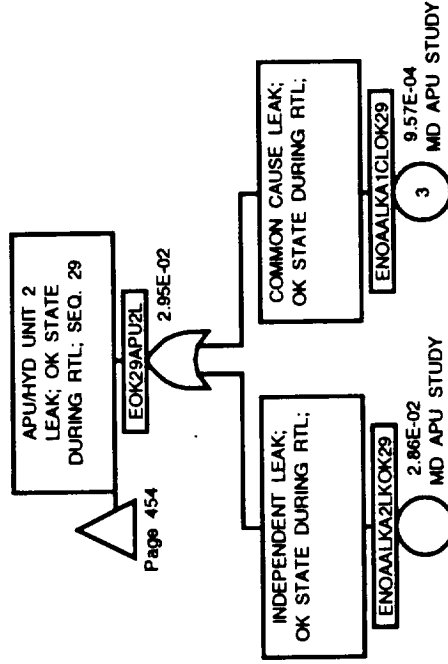




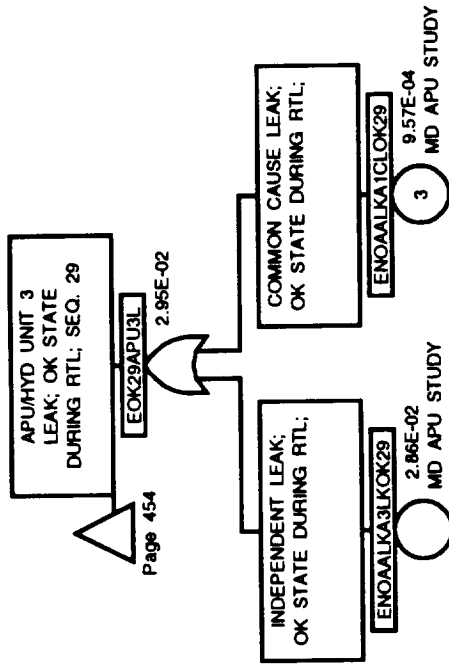


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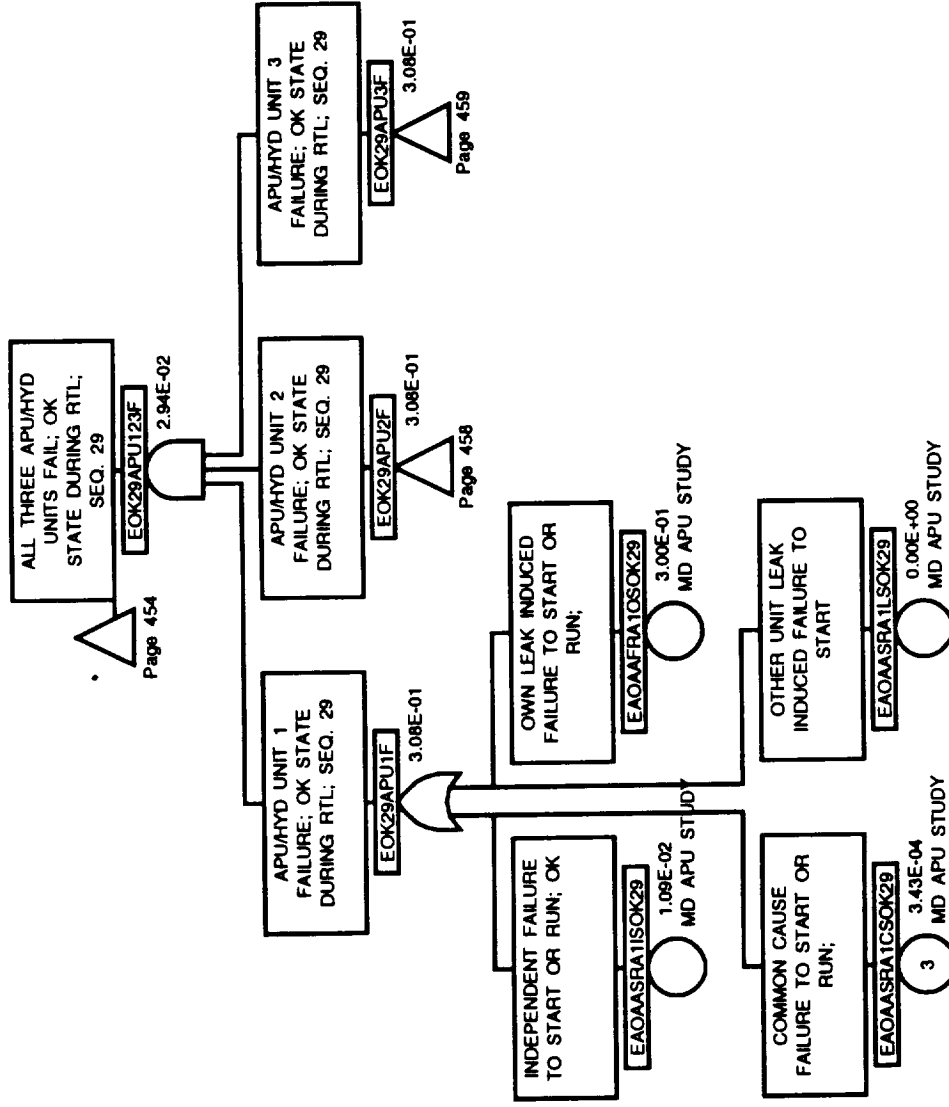


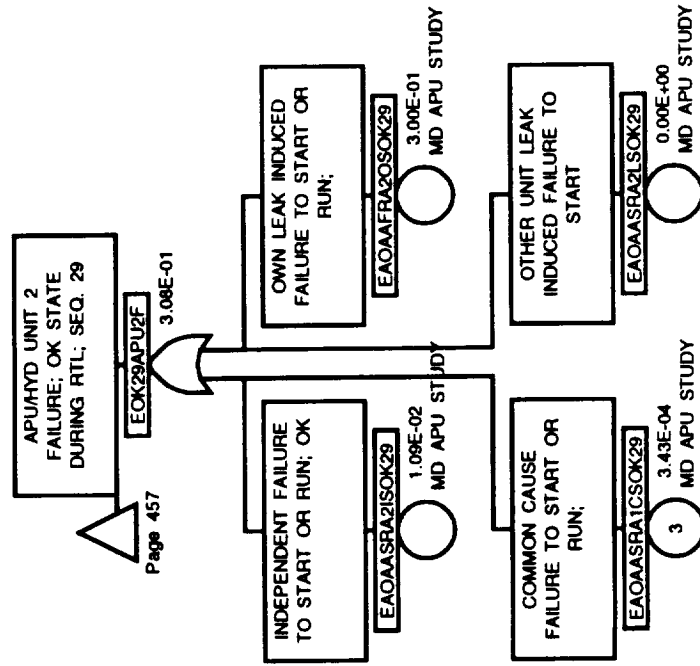


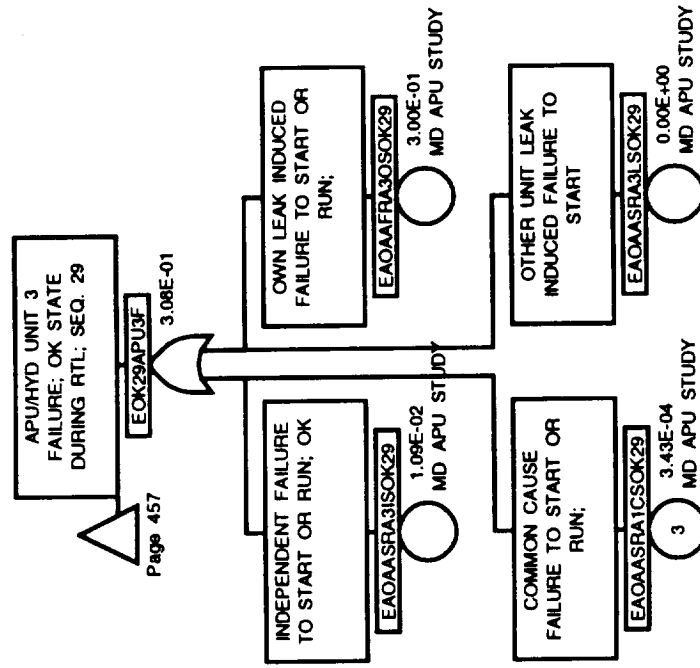
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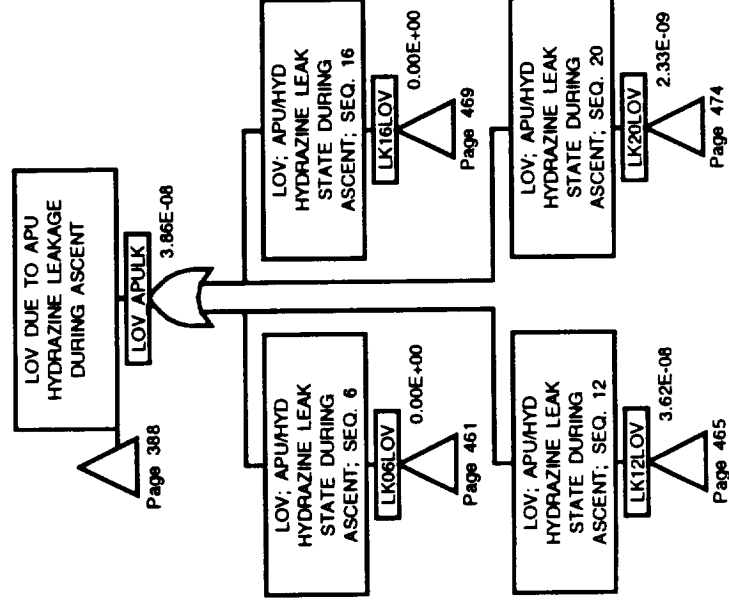
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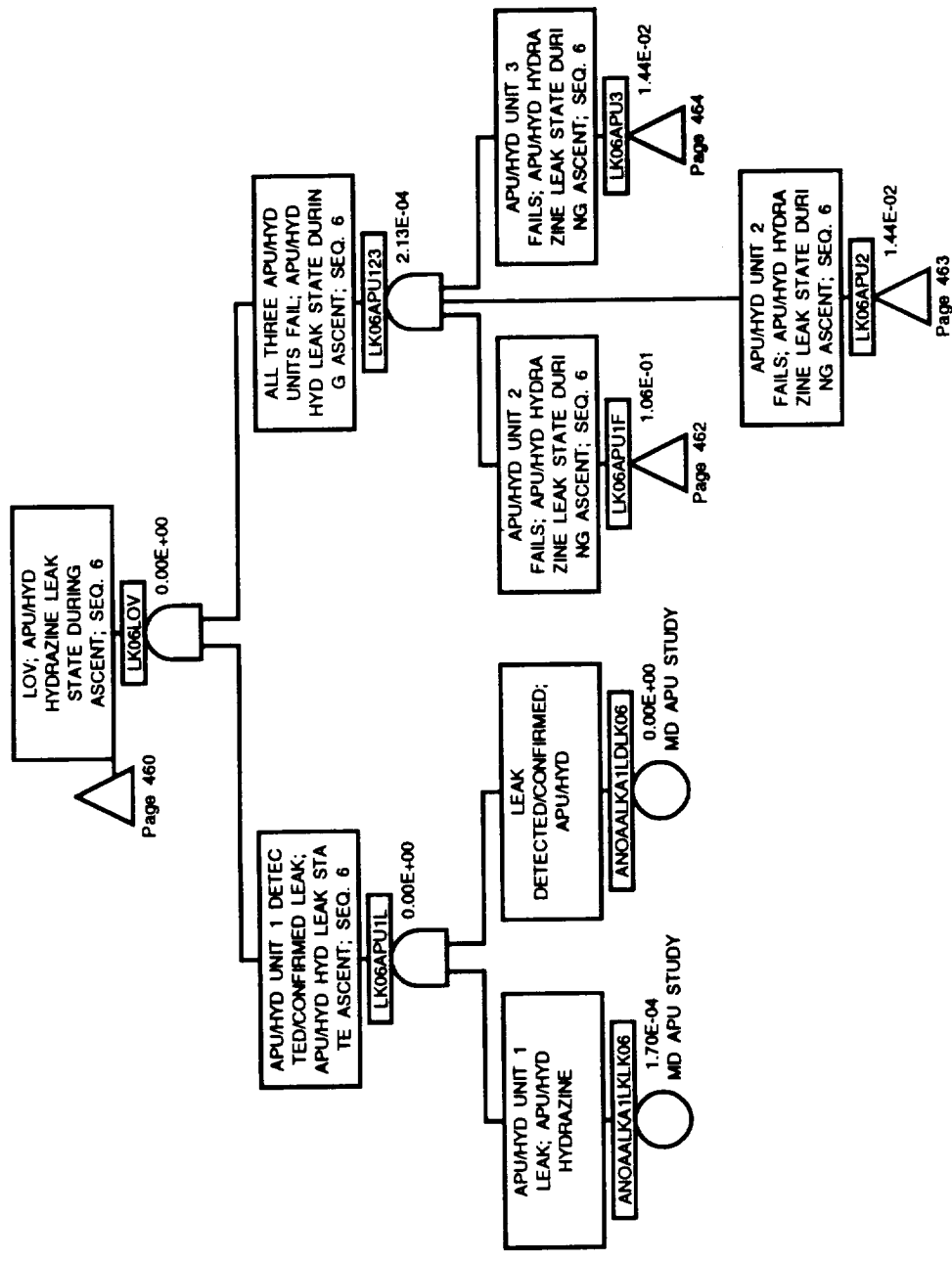


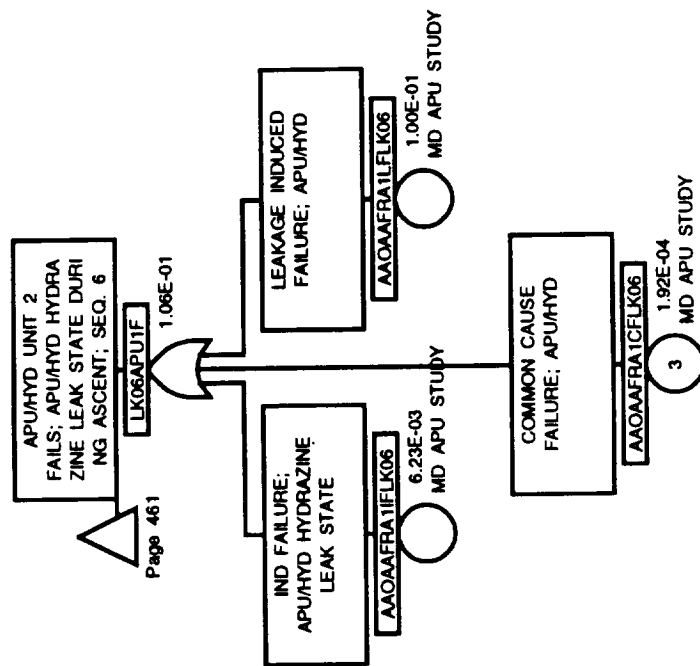


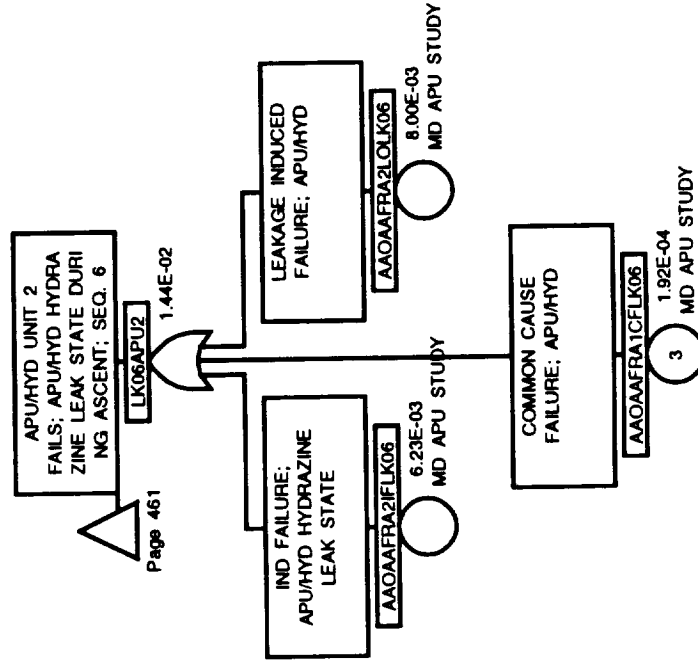


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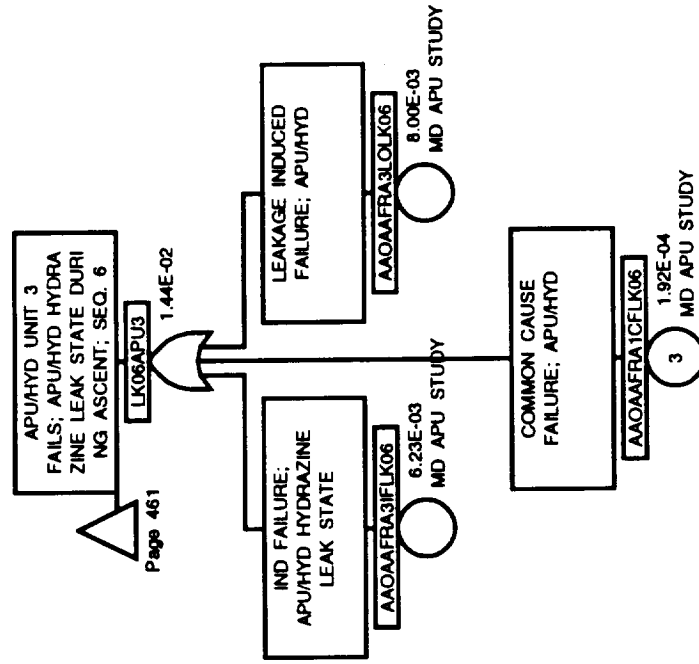




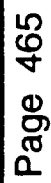


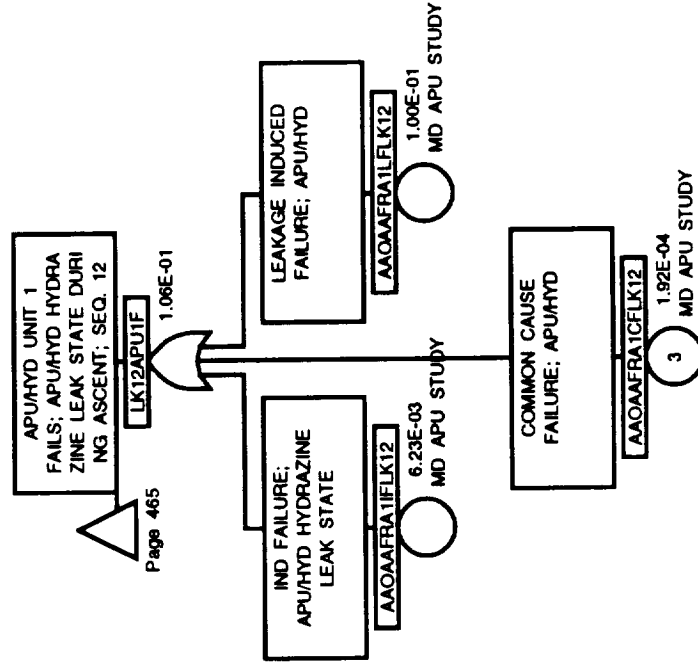


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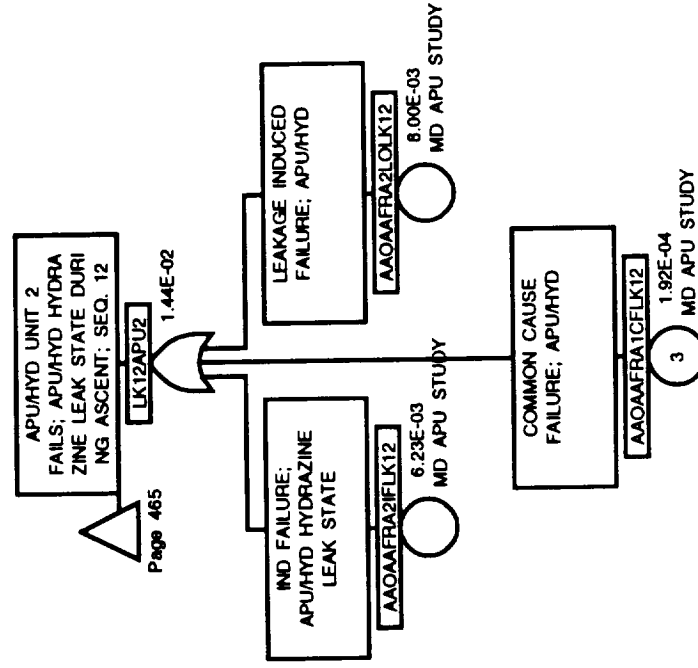


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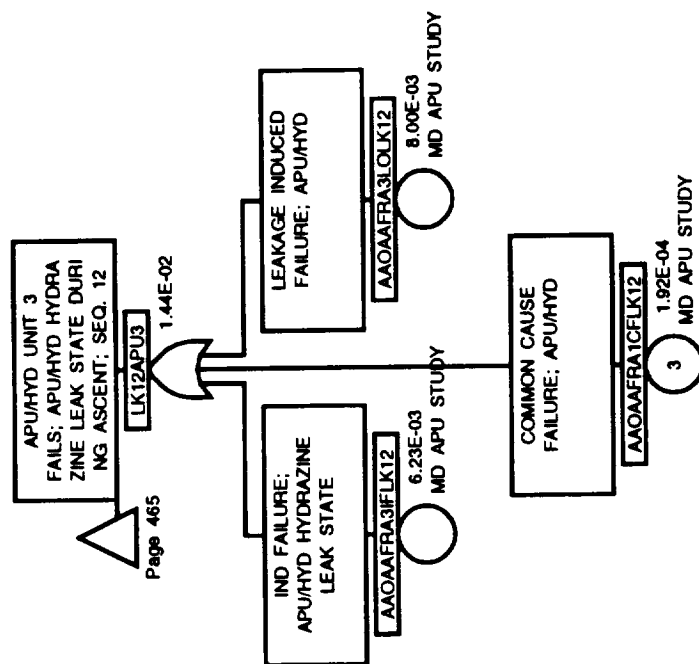




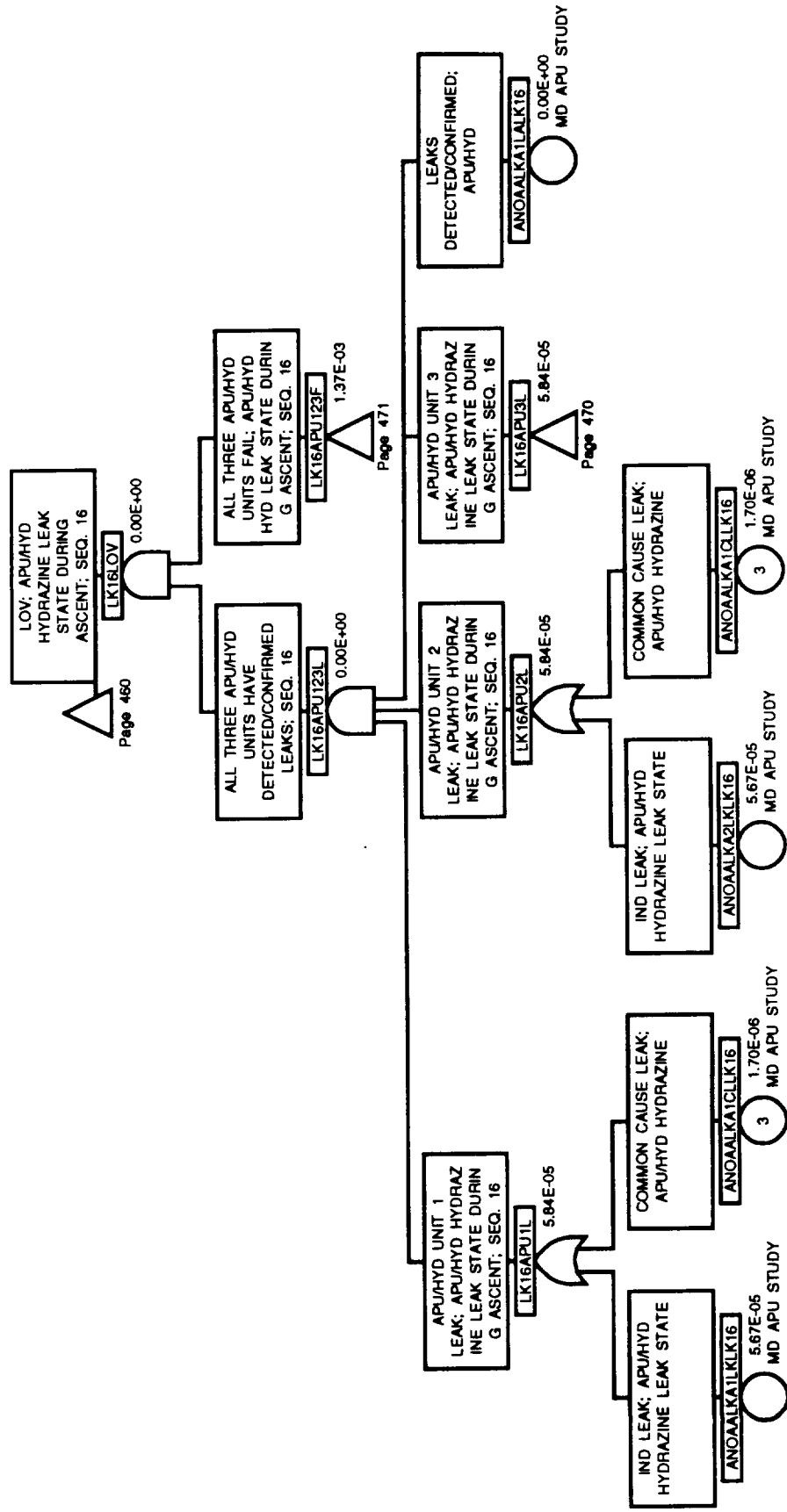
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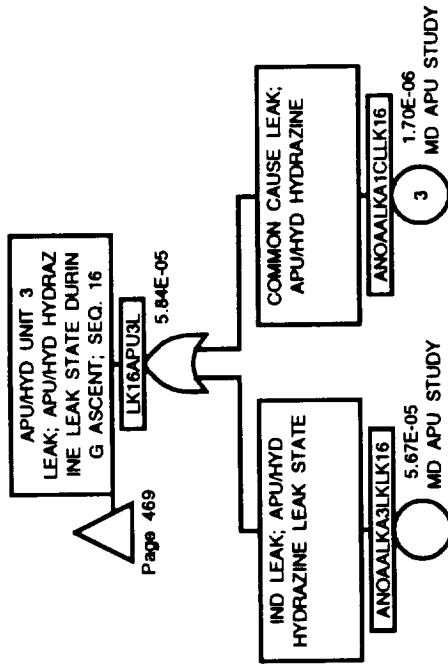


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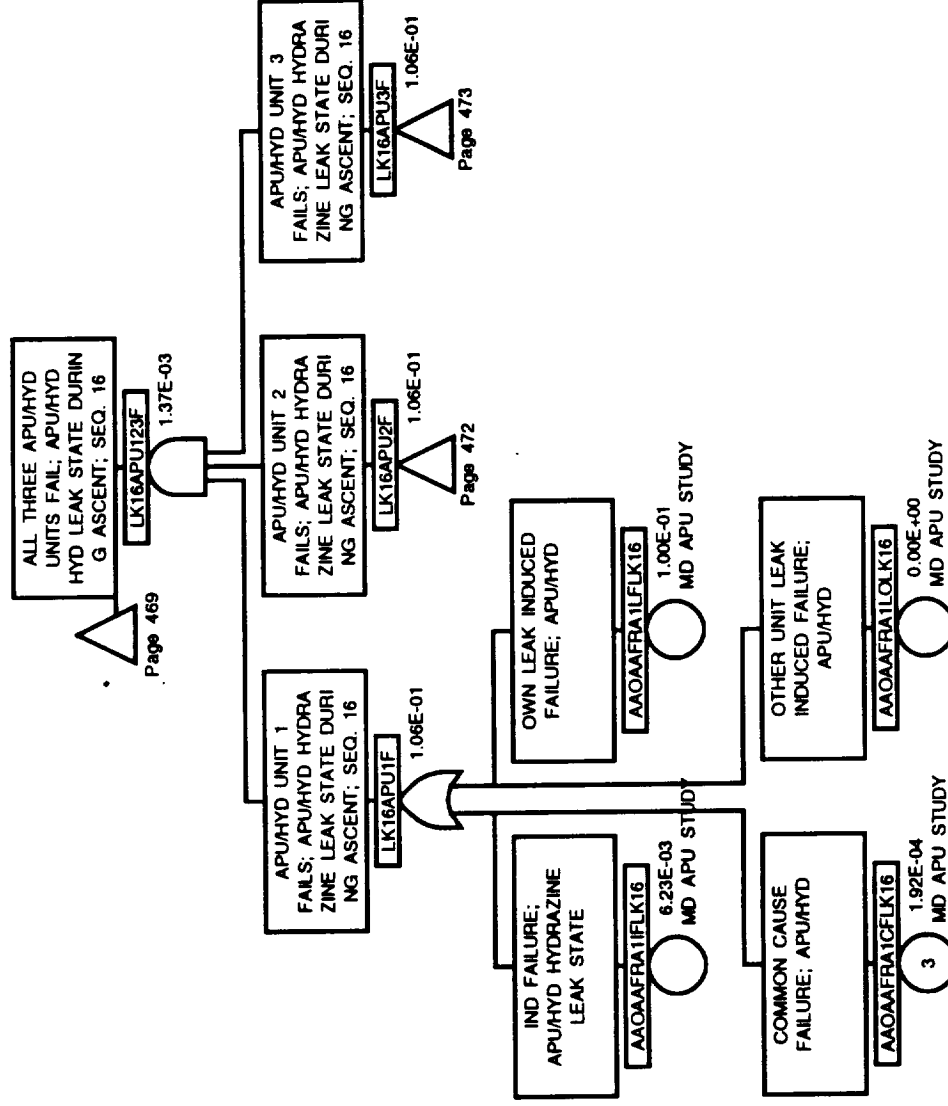


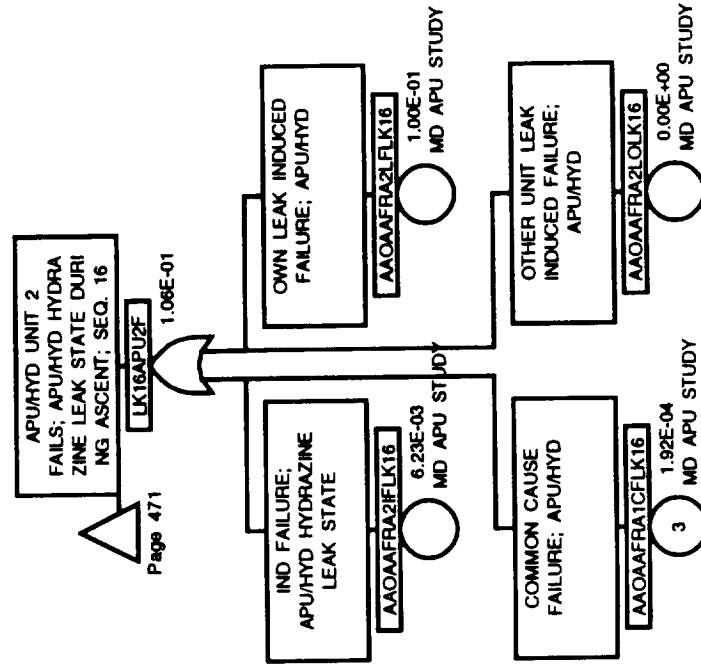
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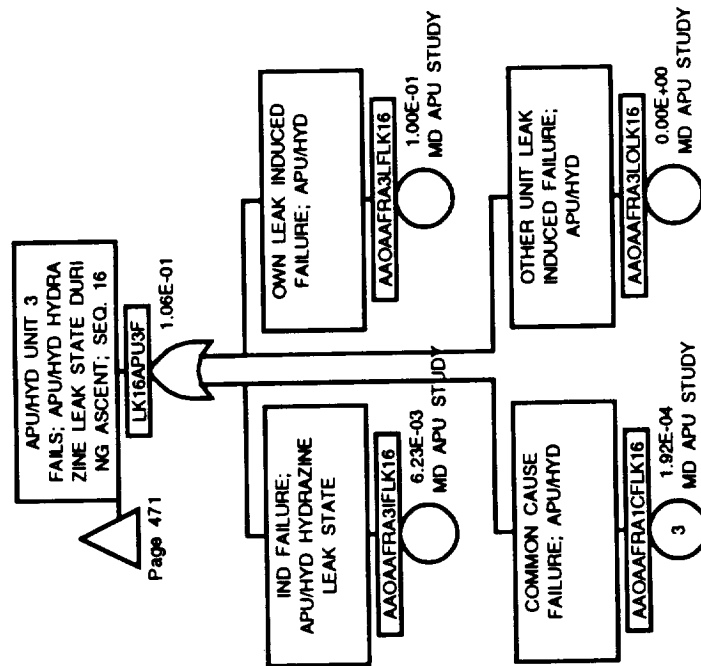


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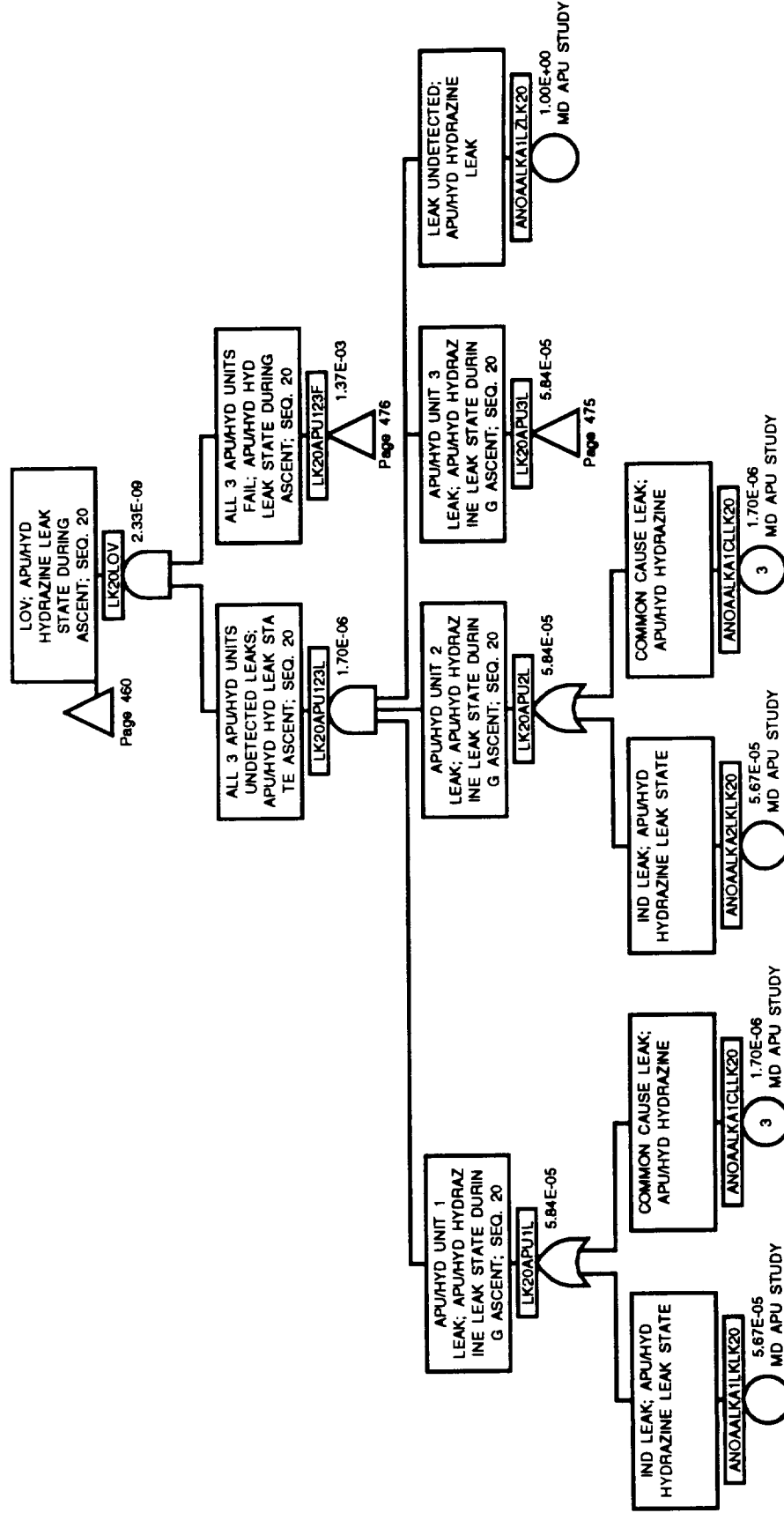


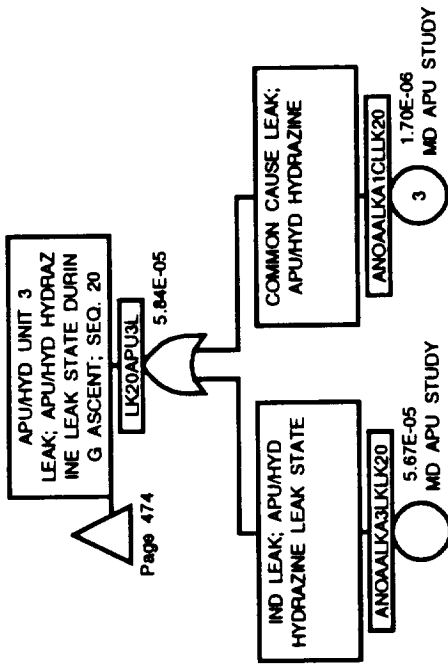


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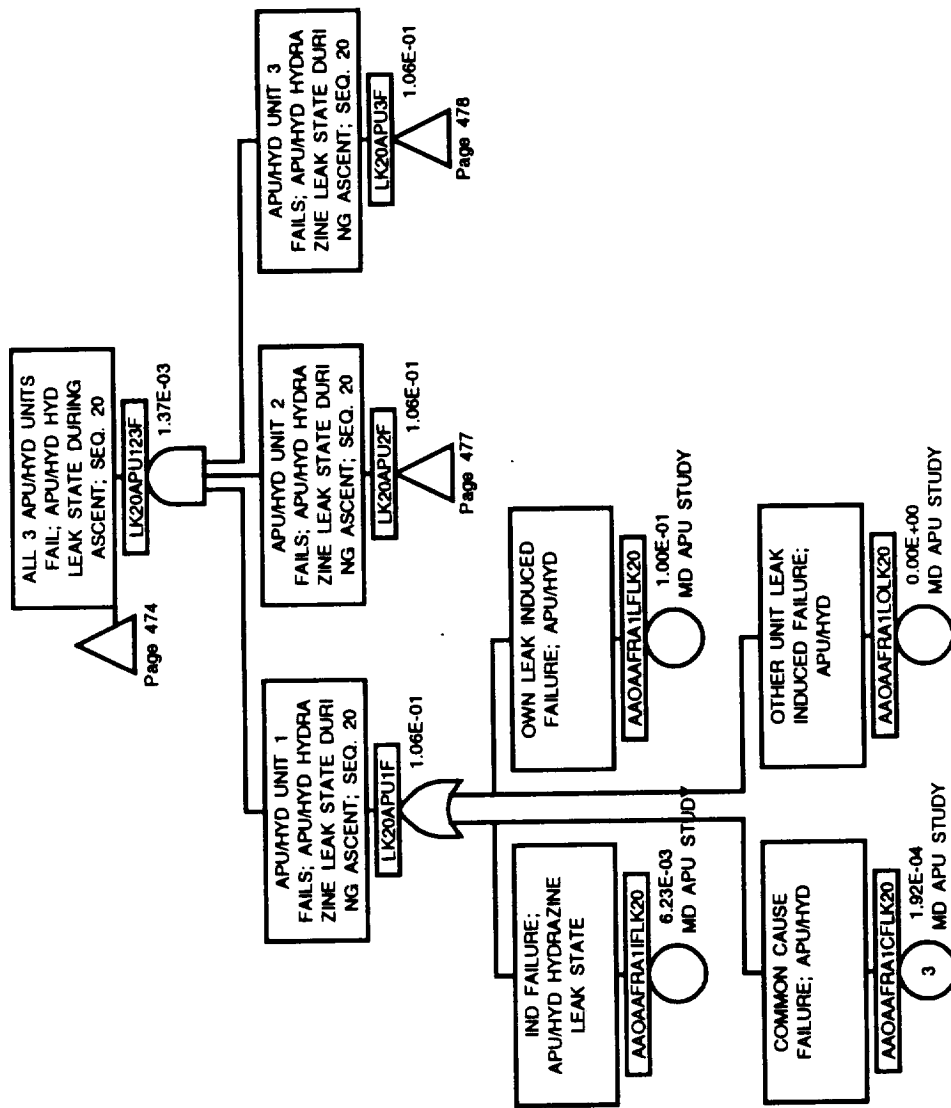


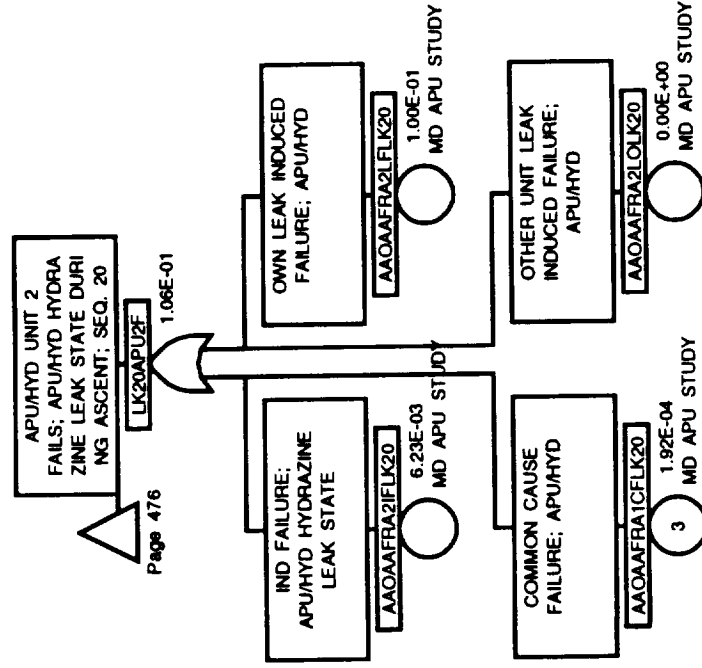
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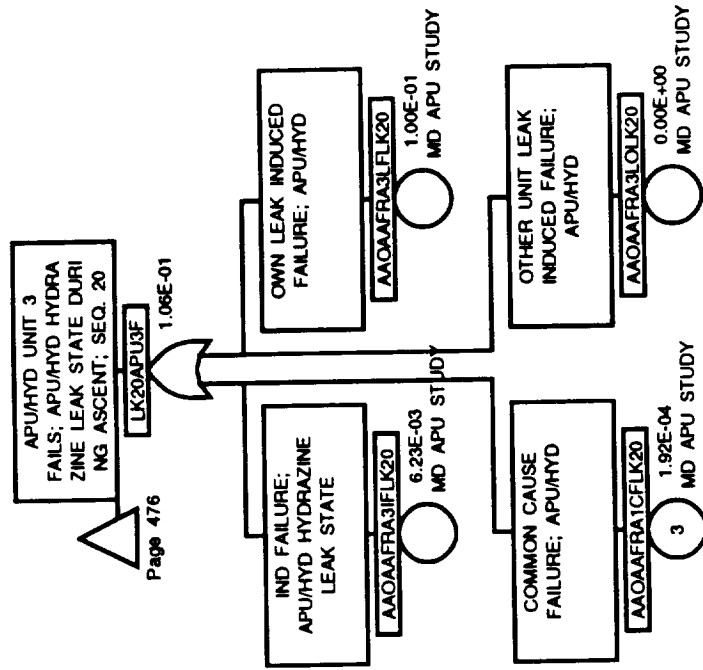


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LOV DURING RE-ENTRY/DESCENT DUE TO ONE LATENT HYDRAZINE LEAKAGE

LOV APU ELO

1.64E-06

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SEQUENCE 4 LOV;
INITIAL LEAK IN 1
APU; SEQ. 4

ELO04LOV

1.37E-07

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SEQUENCE 6 LOV;
INITIAL LEAK IN 1
APU; SEQ. 6

ELO06LOV

1.94E-08

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SEQUENCE 7 LOV;
INITIAL LEAK IN 1
APU; SEQ. 7

ELO07LOV

6.58E-08

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SEQUENCE 11 LOV;
INITIAL LEAK IN 1
APU; SEQ. 11

ELO11LOV

7.51E-07

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SEQUENCE 12 LOV;
INITIAL LEAK IN 1
APU; SEQ. 12

ELO12LOV

3.28E-07

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SEQUENCE 16 LOV;
INITIAL LEAK IN 1
APU; SEQ. 16

ELO16LOV

1.60E-08

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SEQUENCE 18 LOV;
INITIAL LEAK IN 1
APU; SEQ. 18

ELO18LOV

9.69E-09

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SEQUENCE 19 LOV;
INITIAL LEAK IN 1
APU; SEQ. 19

ELO19LOV

3.49E-08

Page 510

SEQUENCE 23 LOV;
INITIAL LEAK IN 1
APU; SEQ. 23

ELO23LOV

1.11E-07

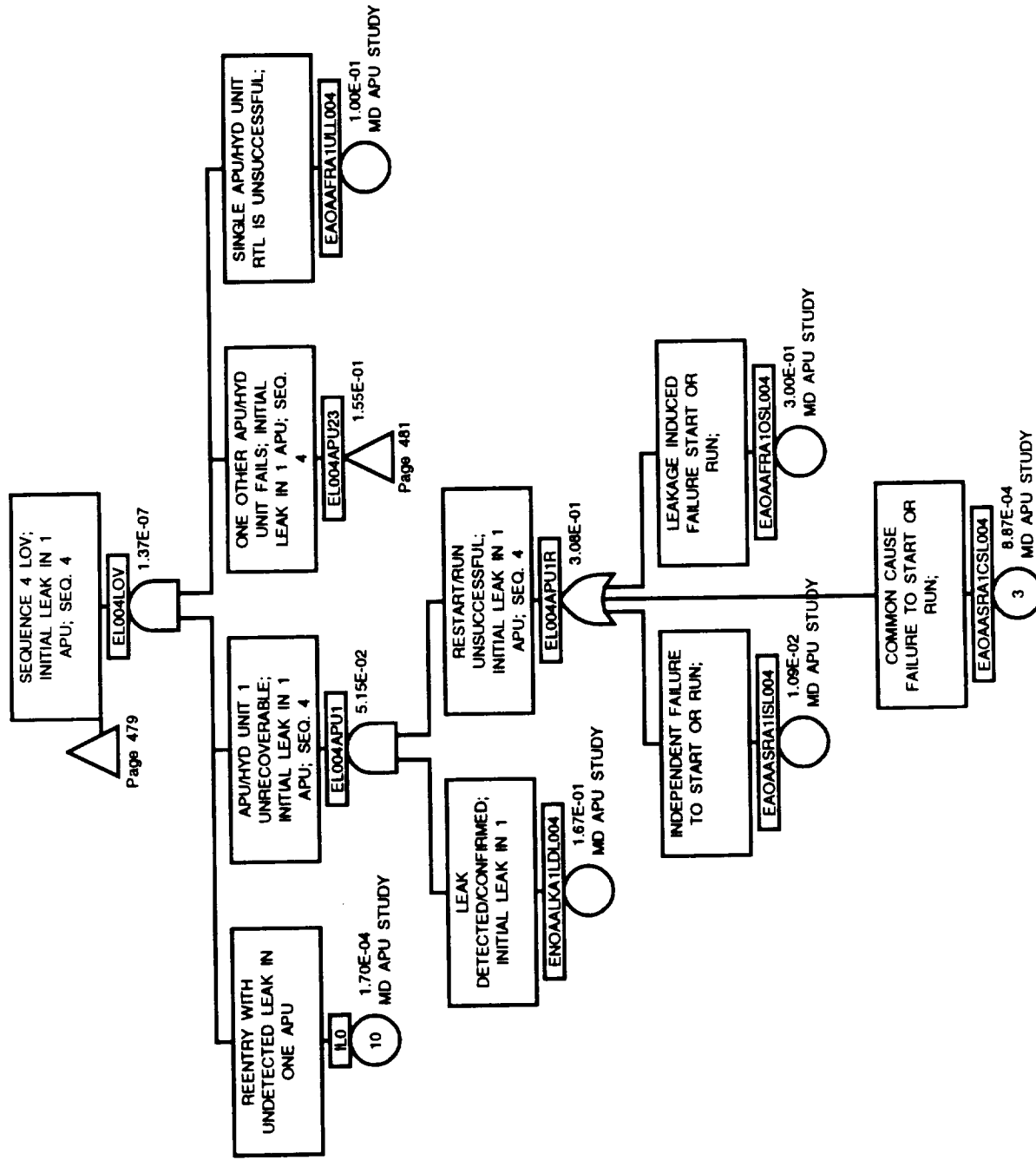
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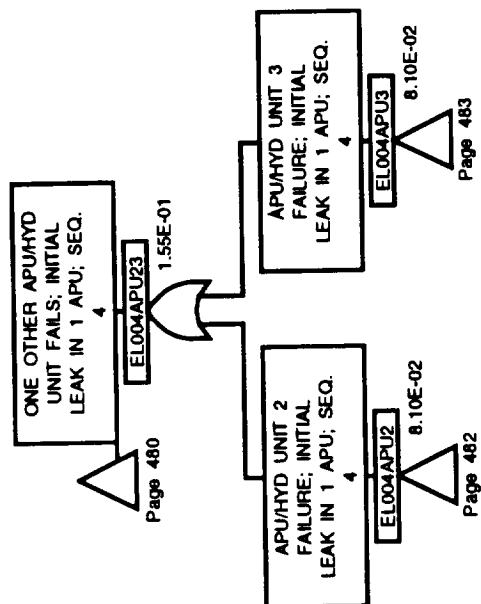
SEQUENCE 24 LOV;
INITIAL LEAK IN 1
APU; SEQ. 24

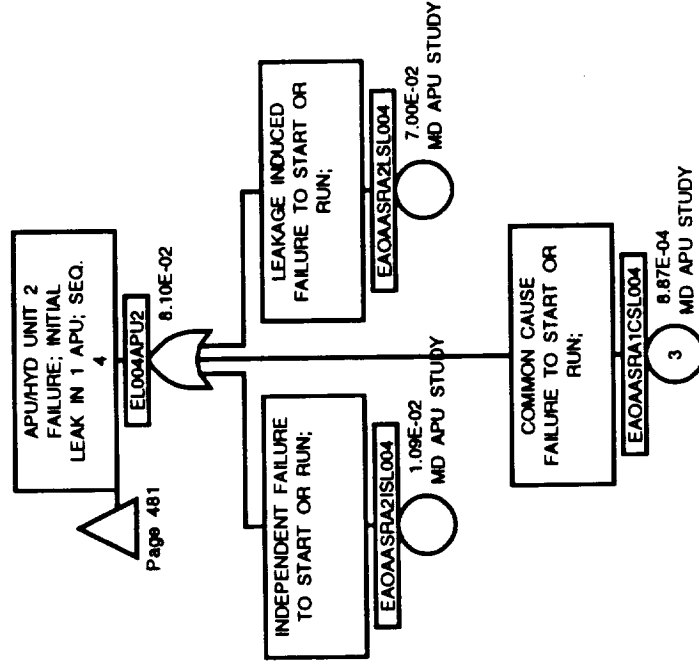
ELO24LOV

1.74E-07

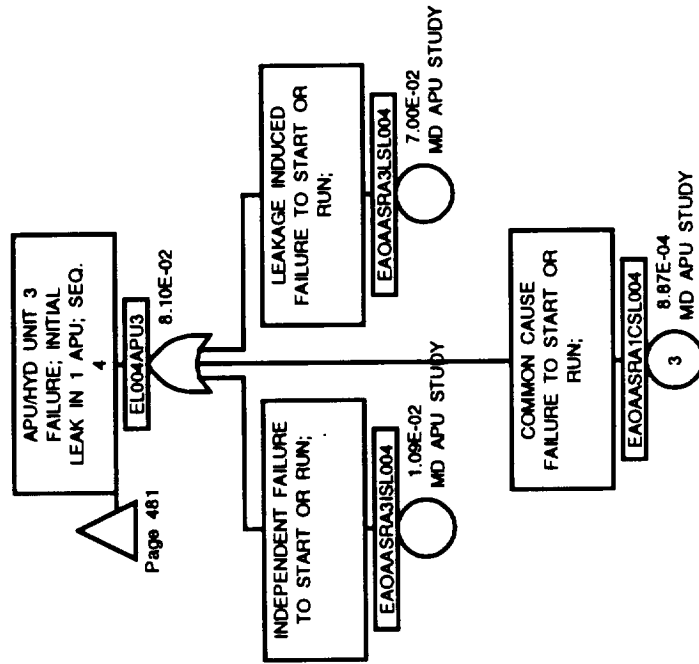
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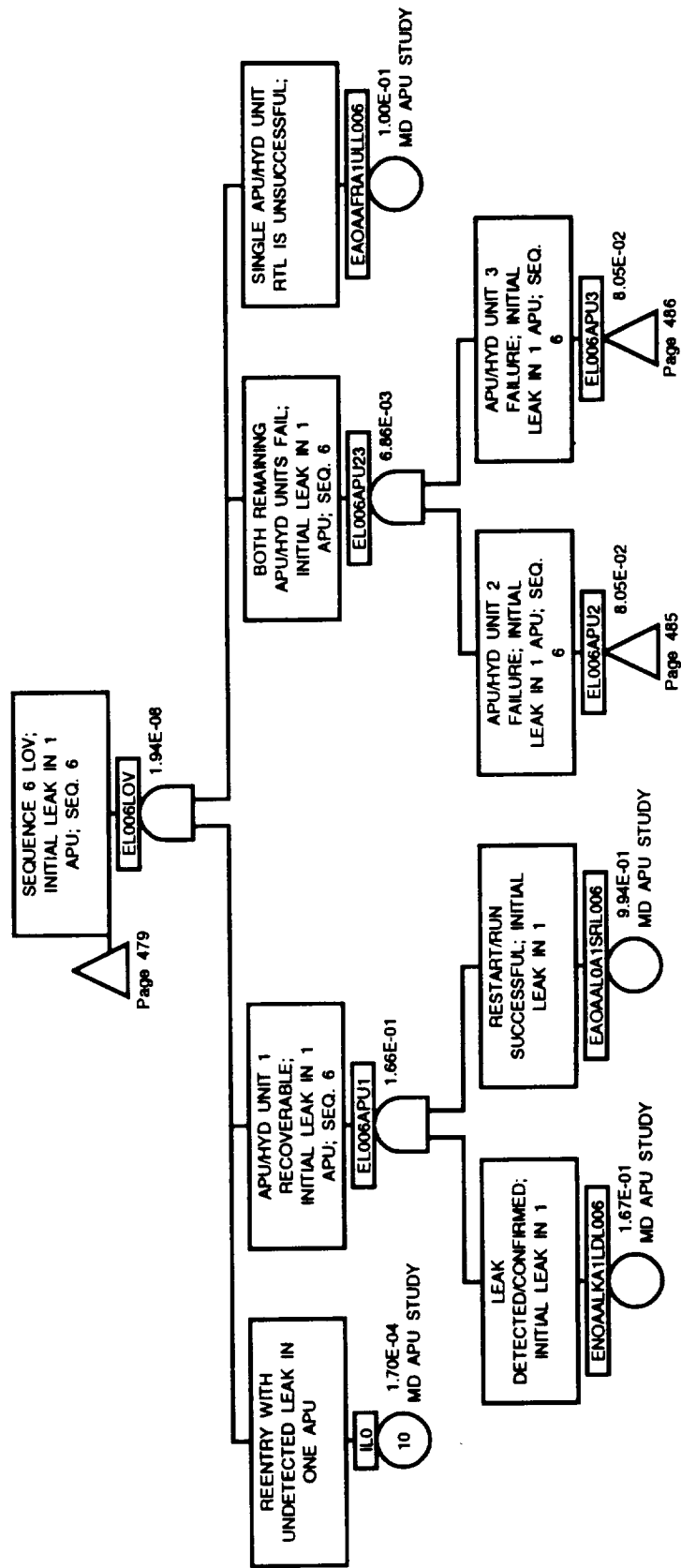


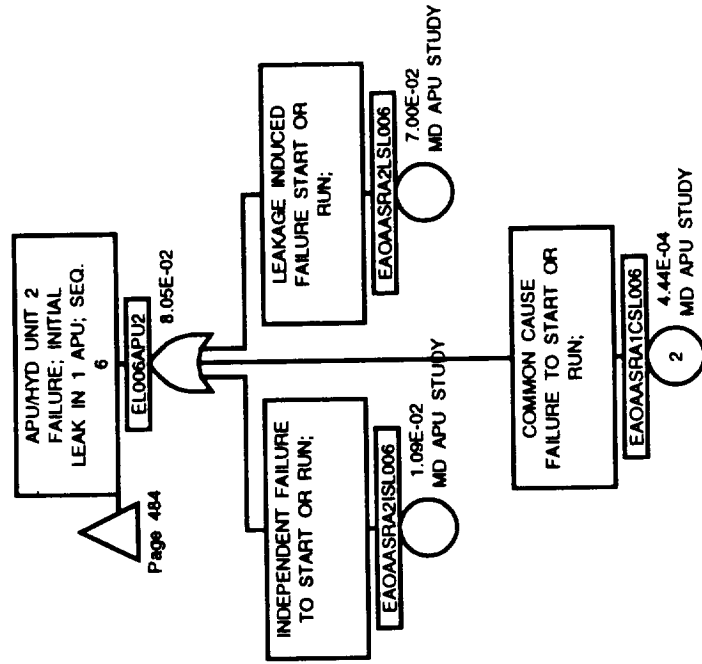




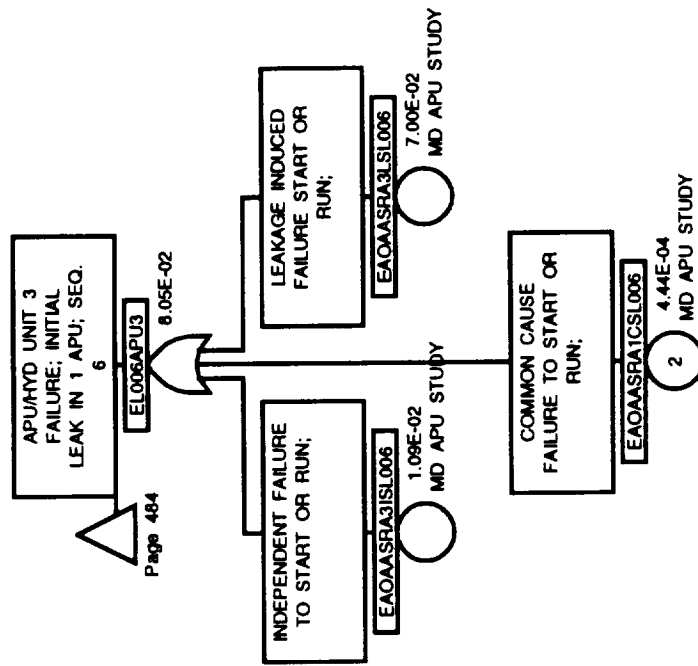
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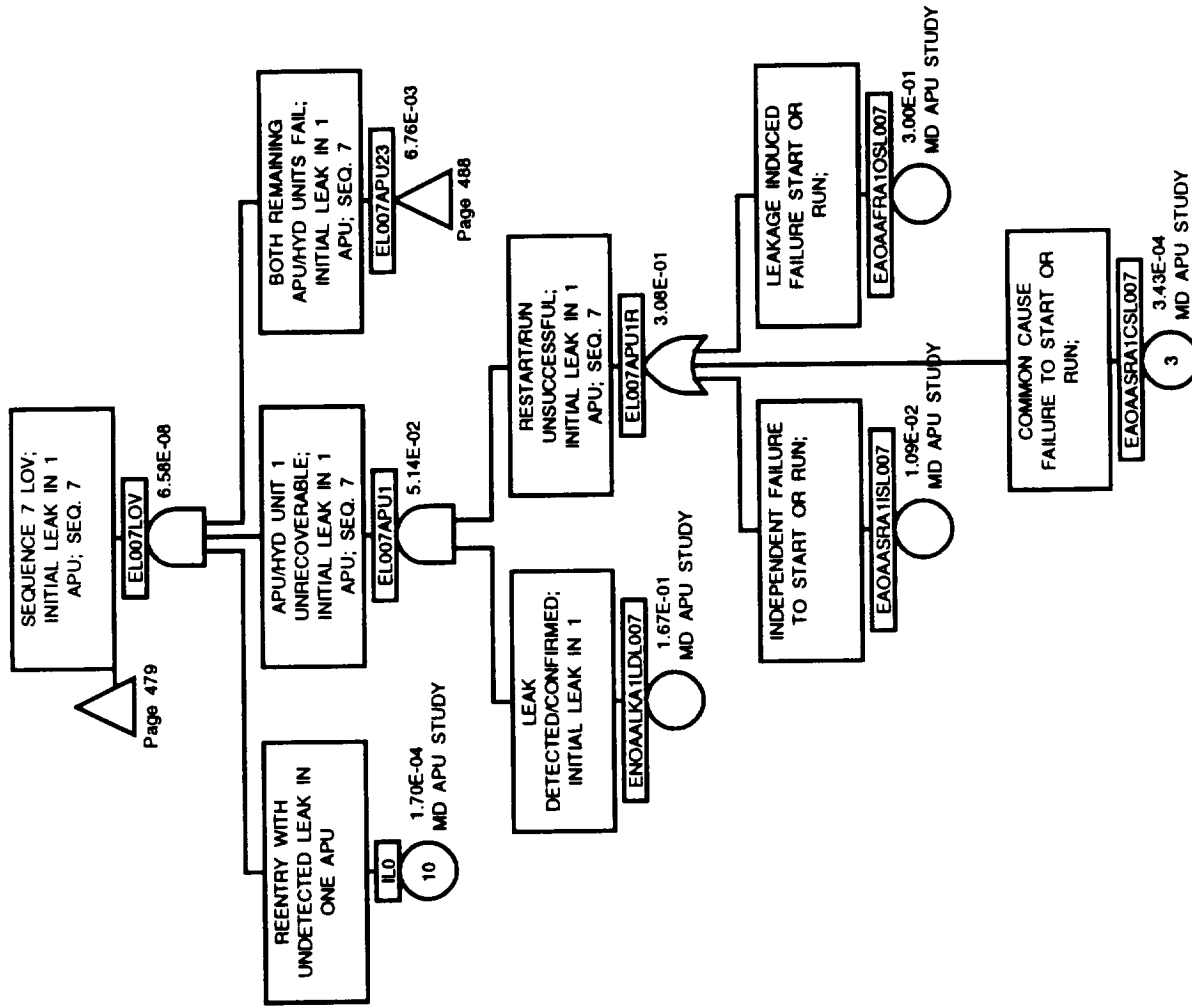


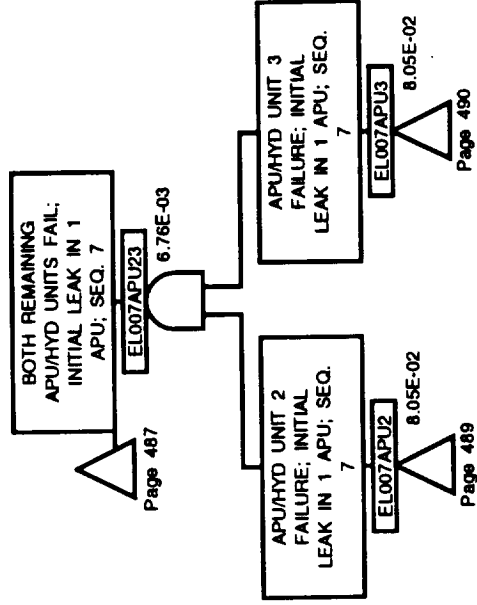


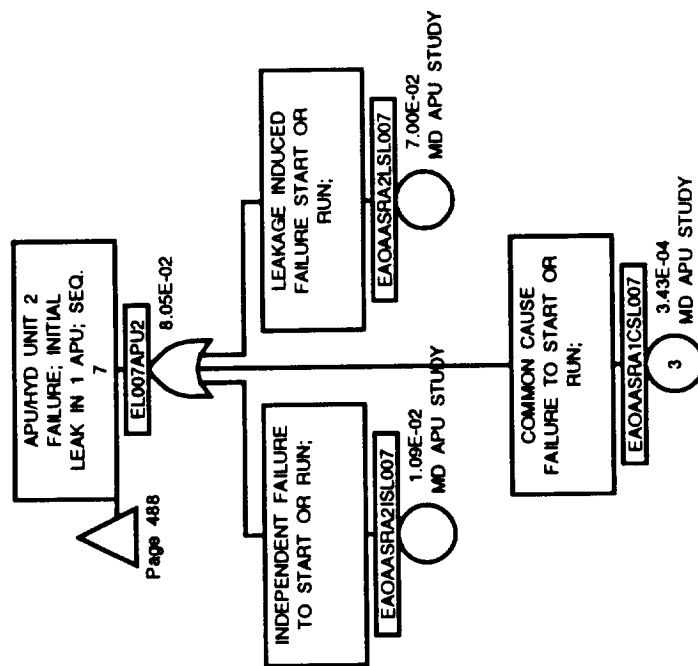


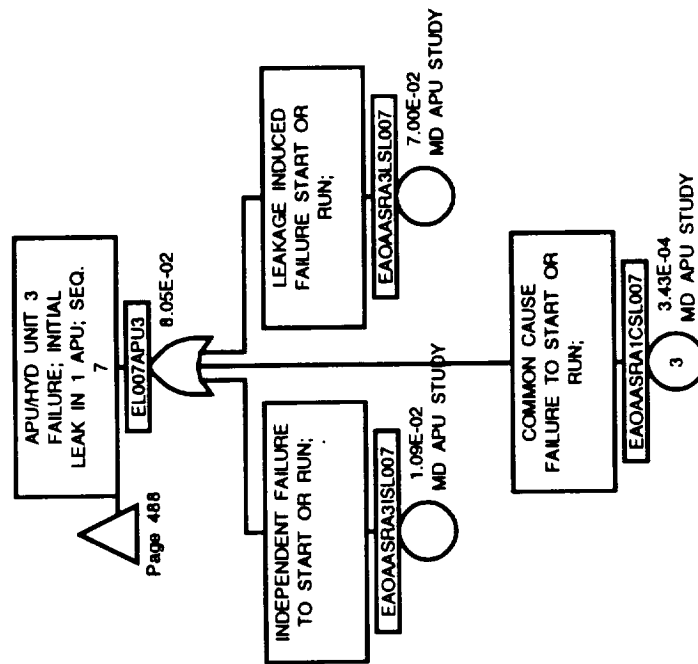
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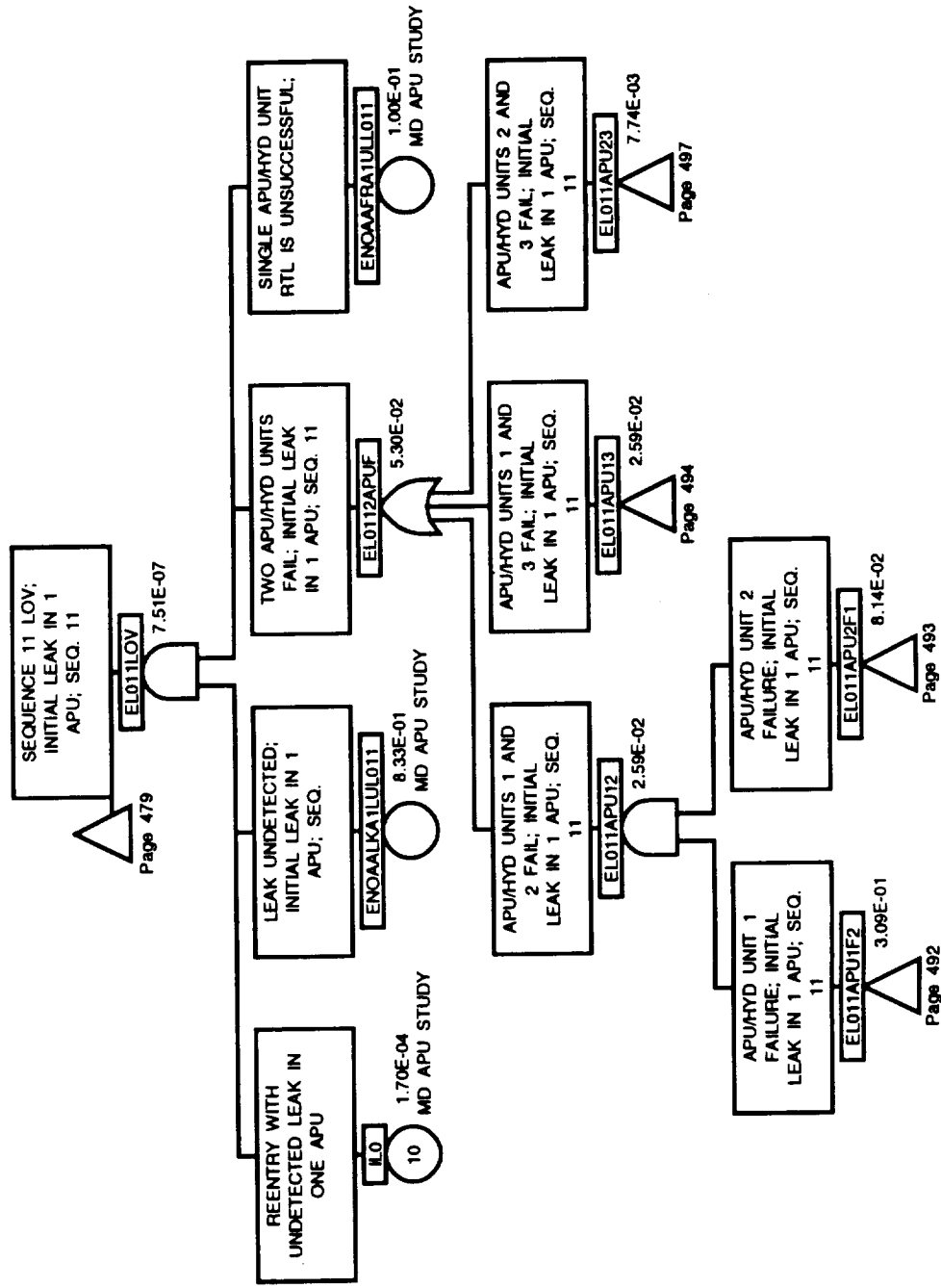


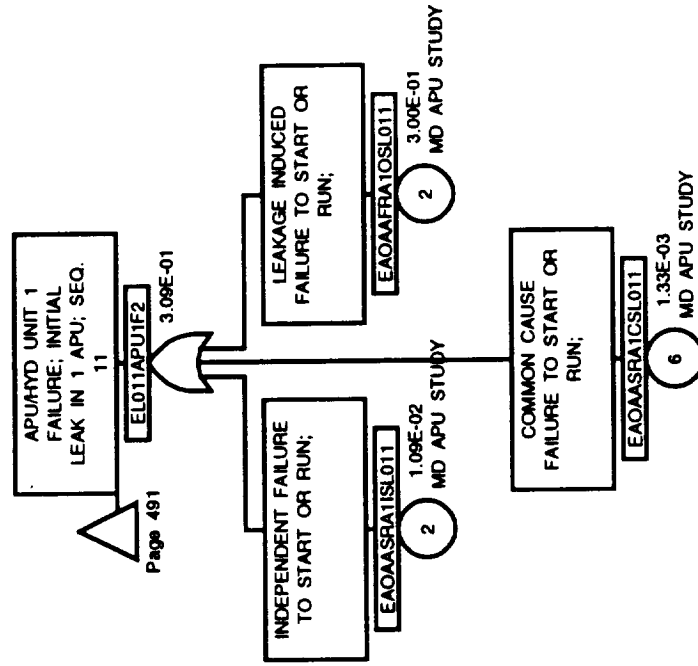




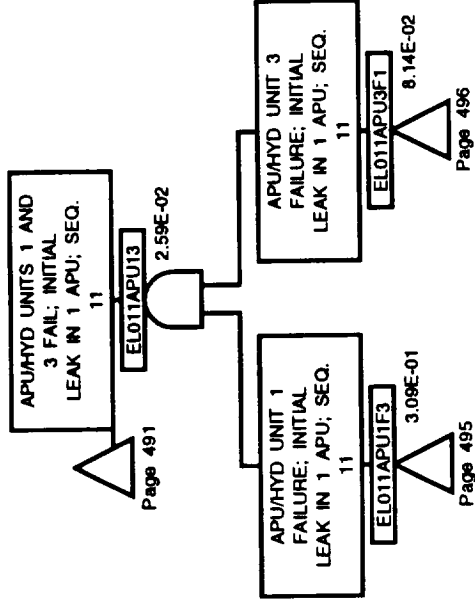


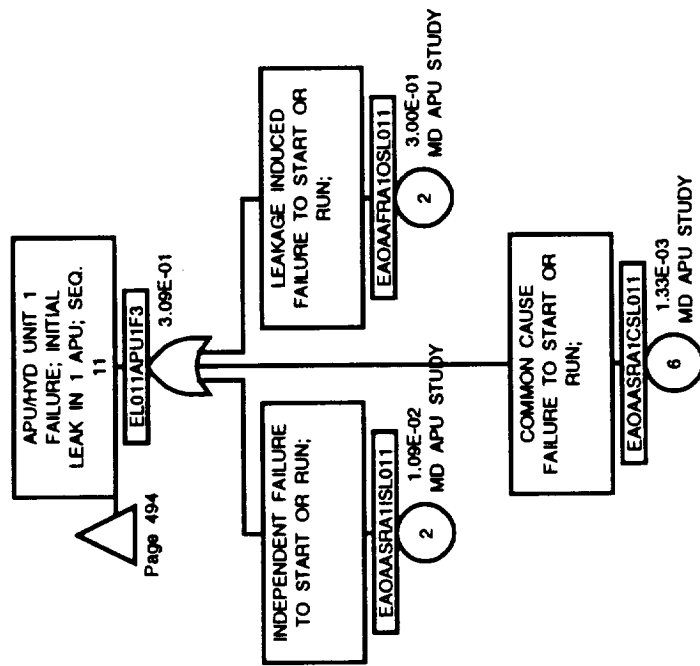




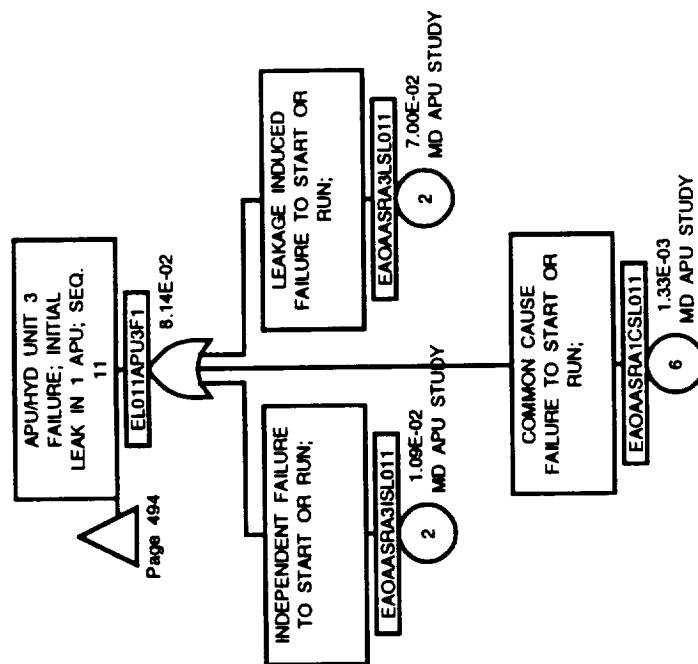


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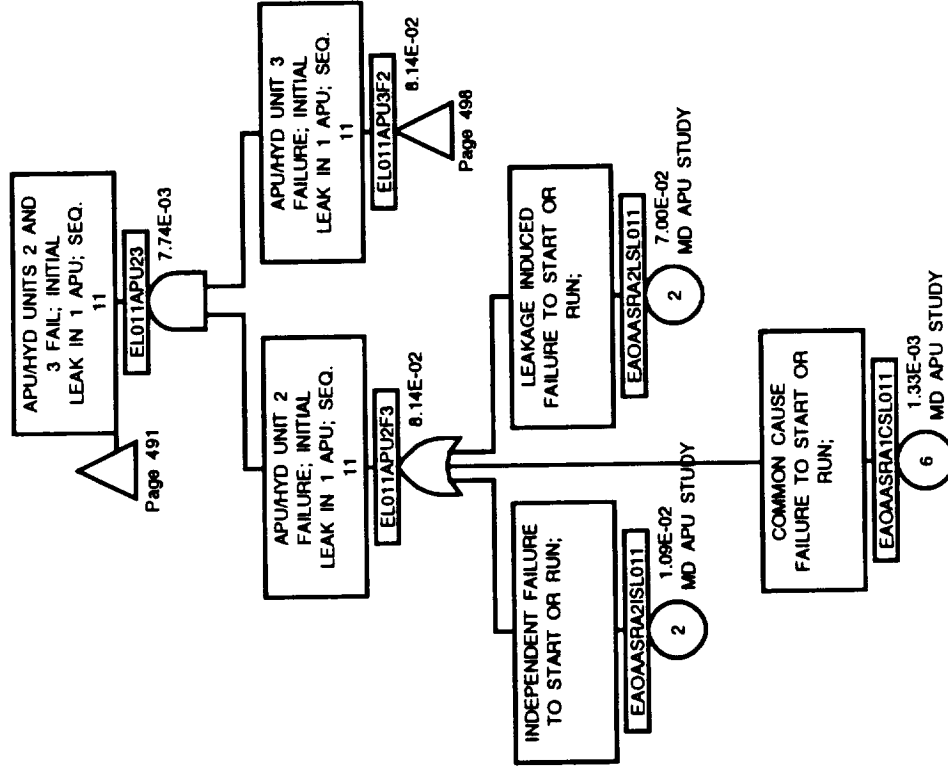


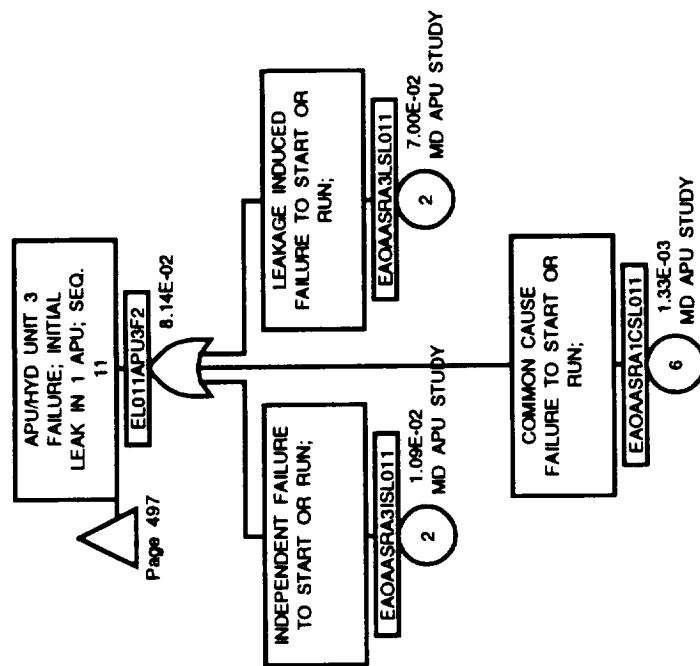


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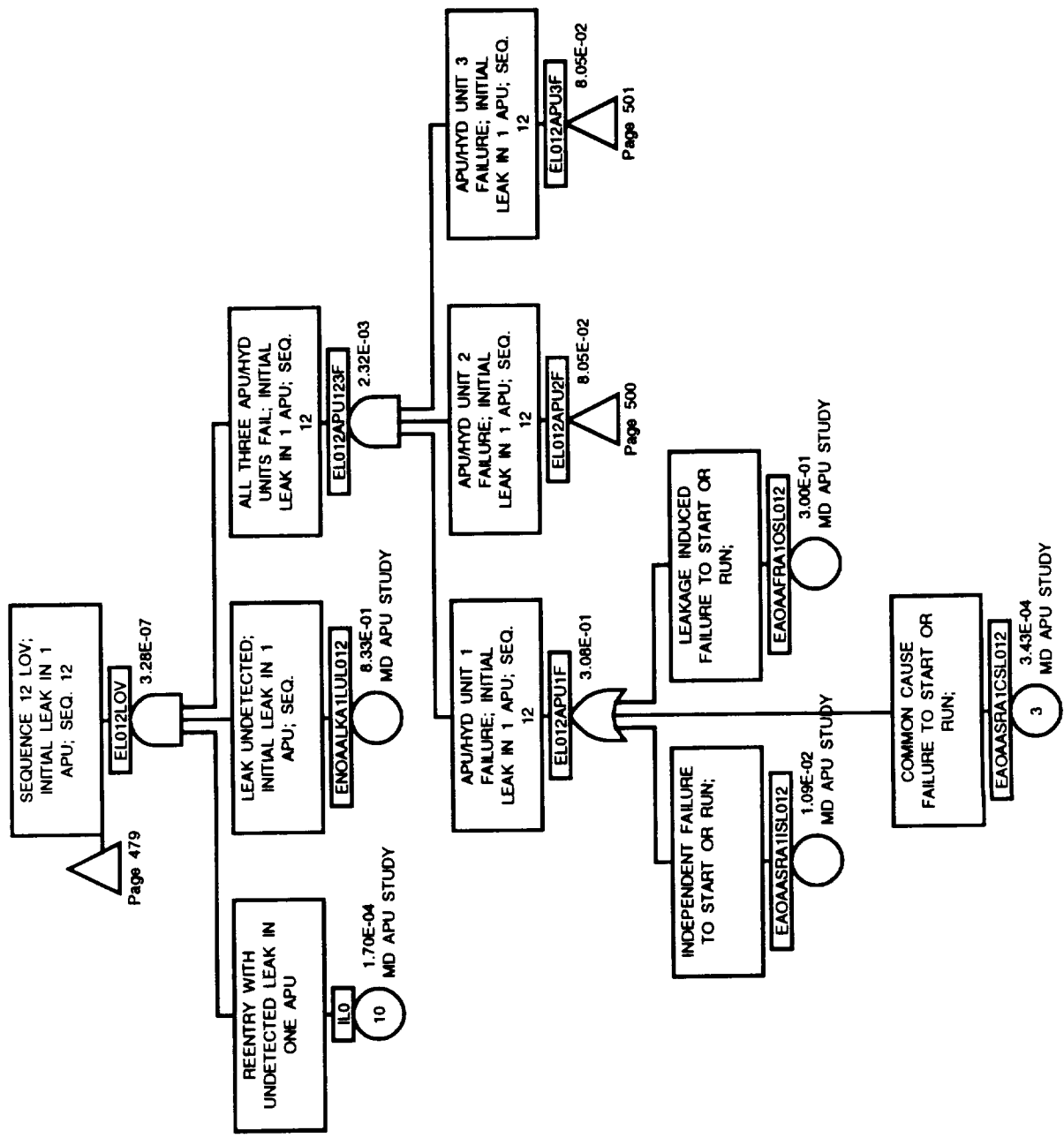


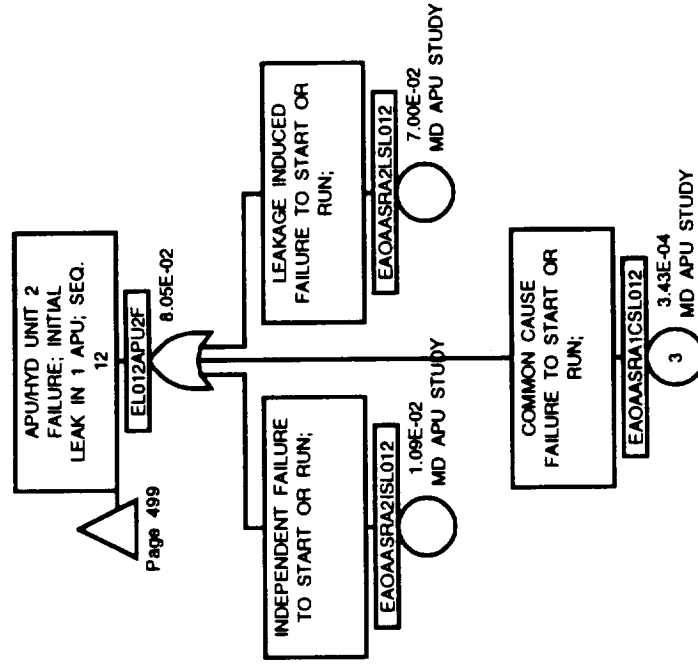
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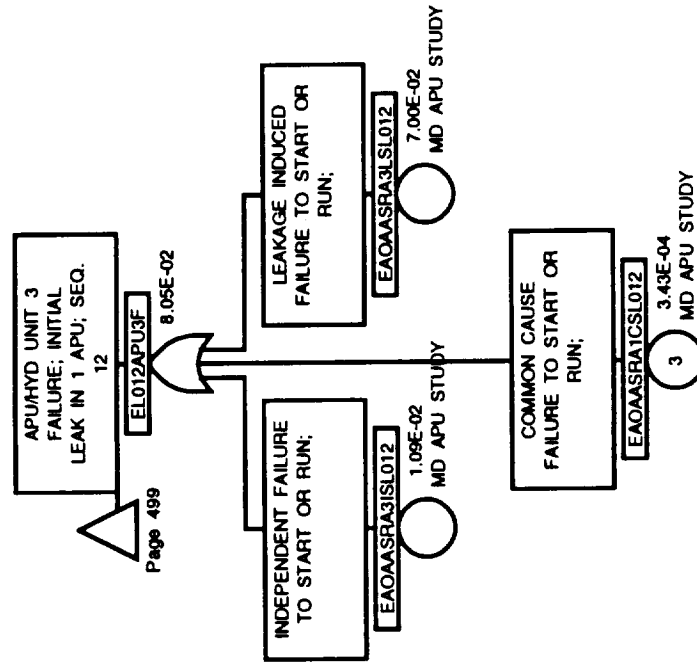


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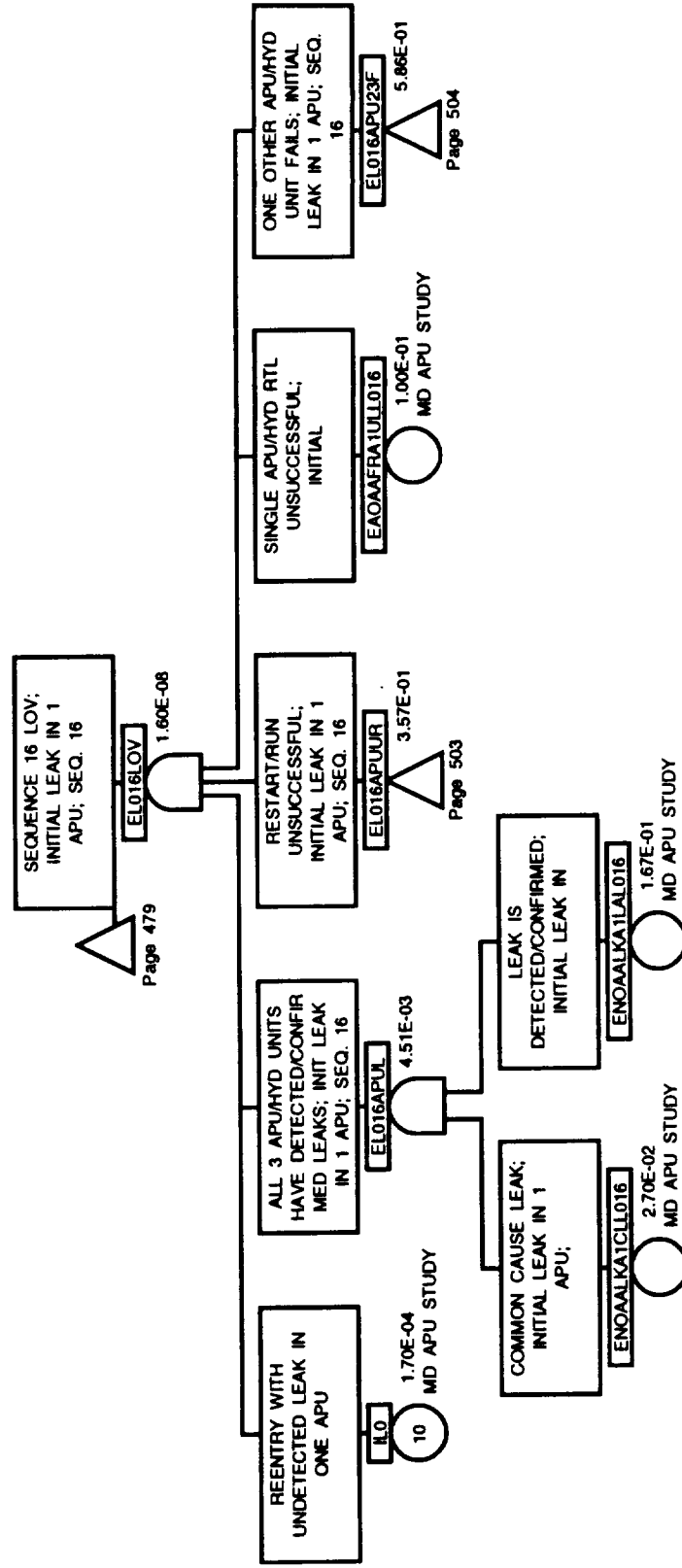


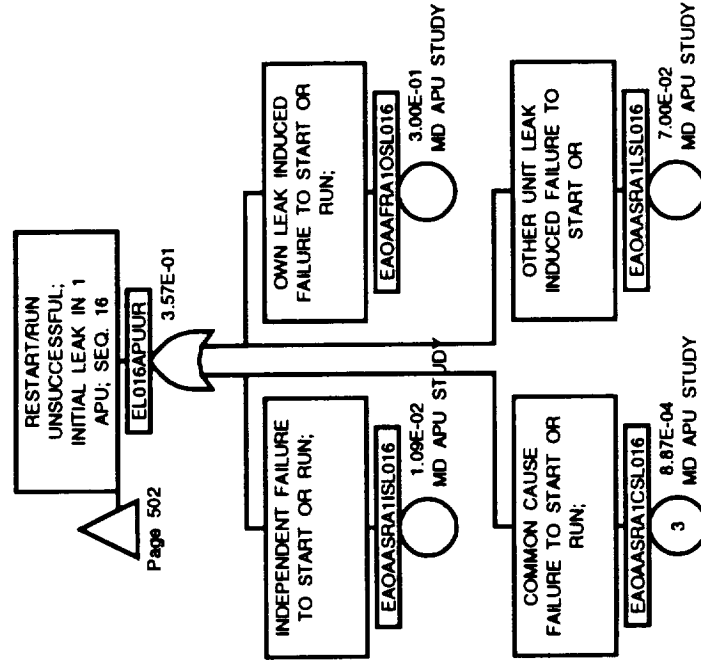


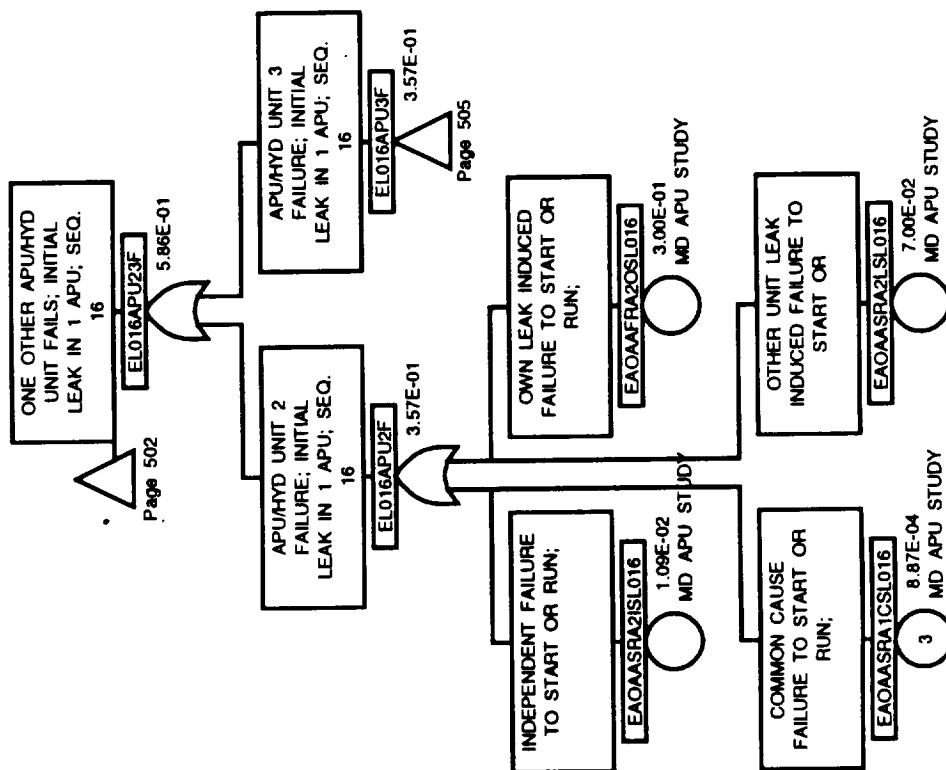
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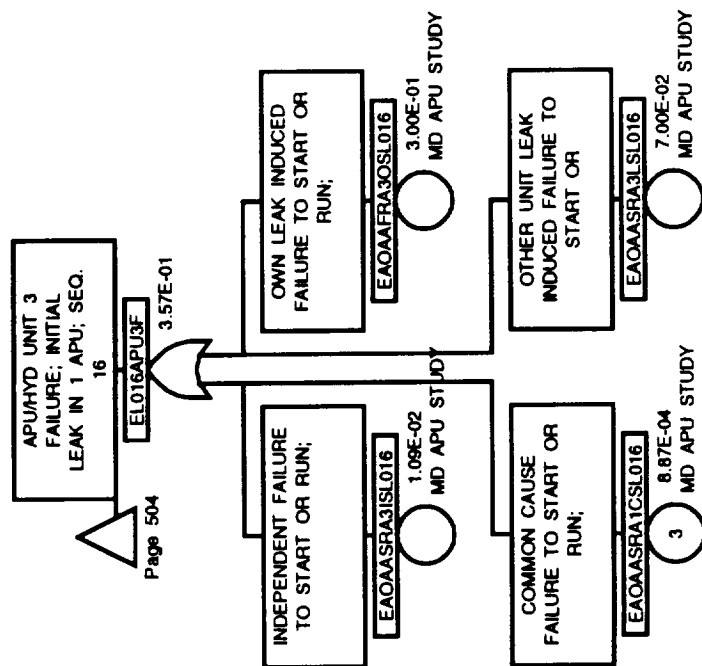


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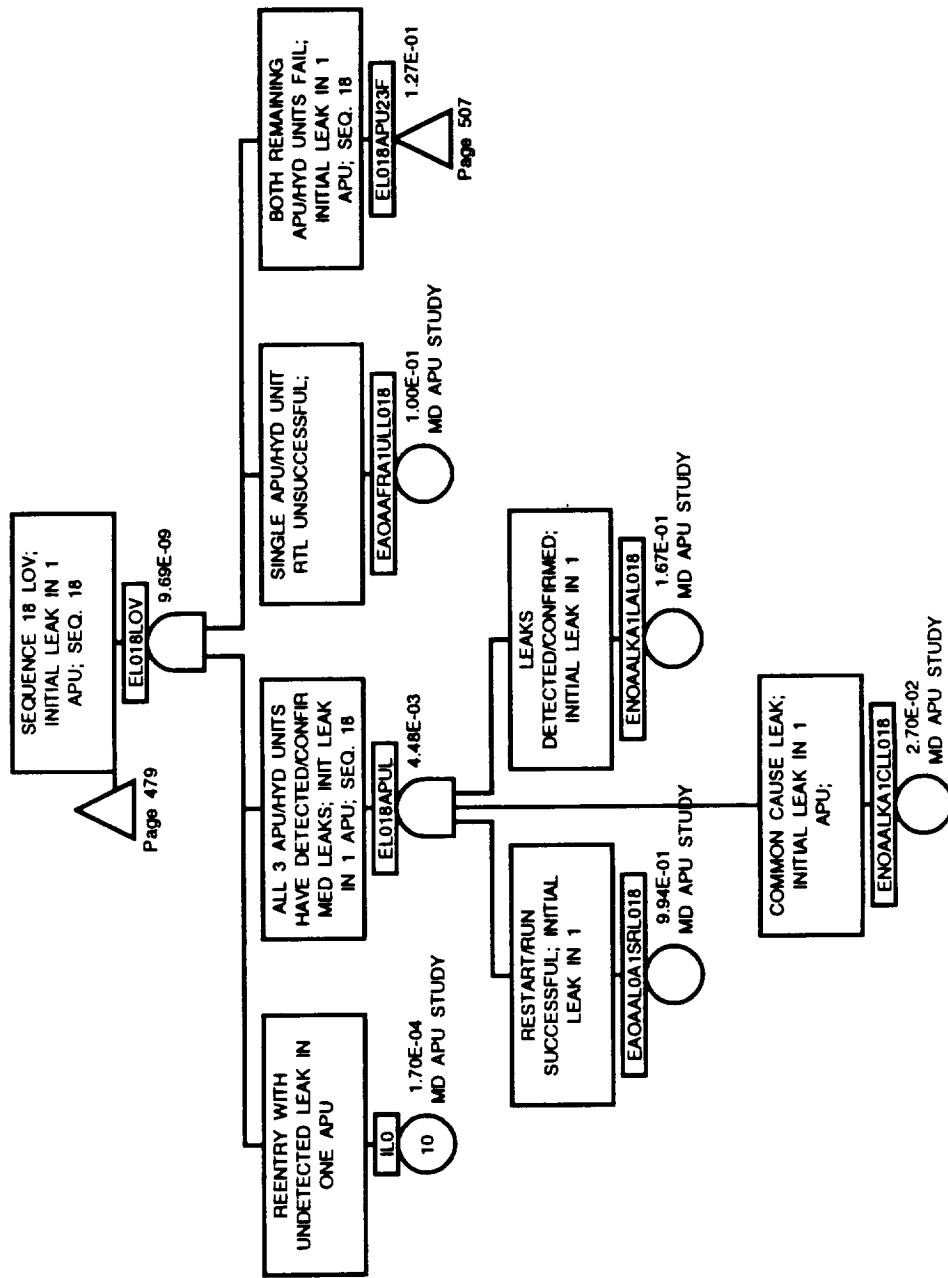


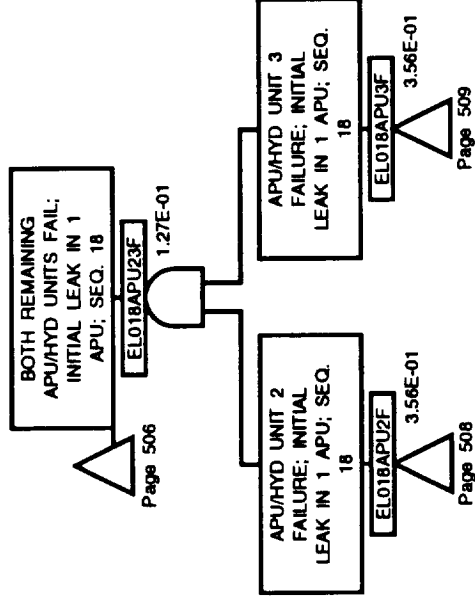


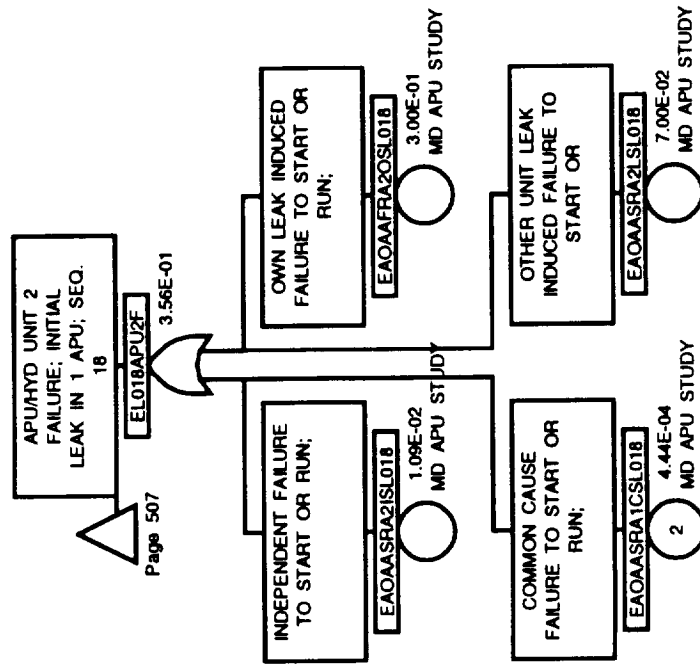




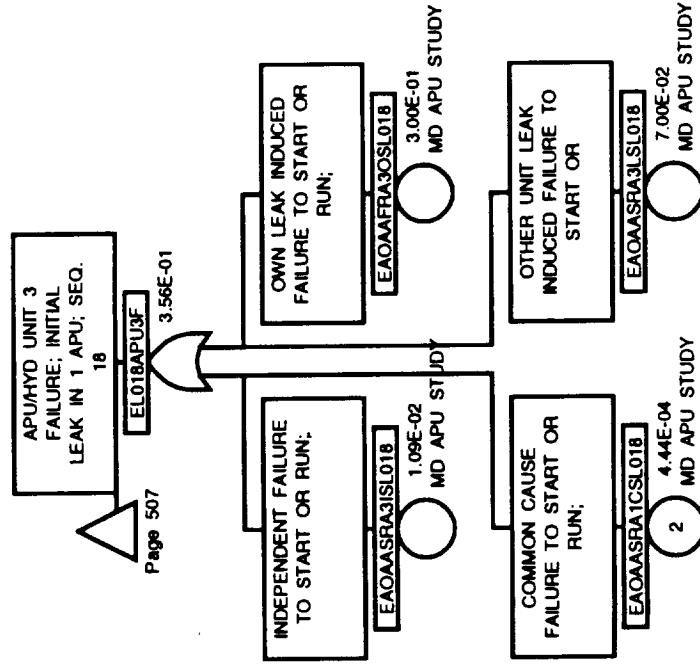
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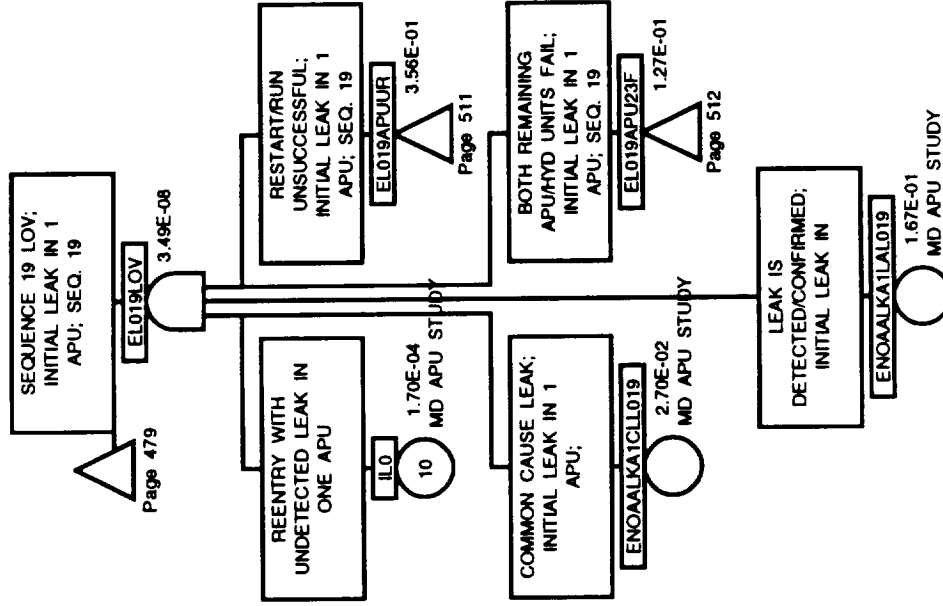


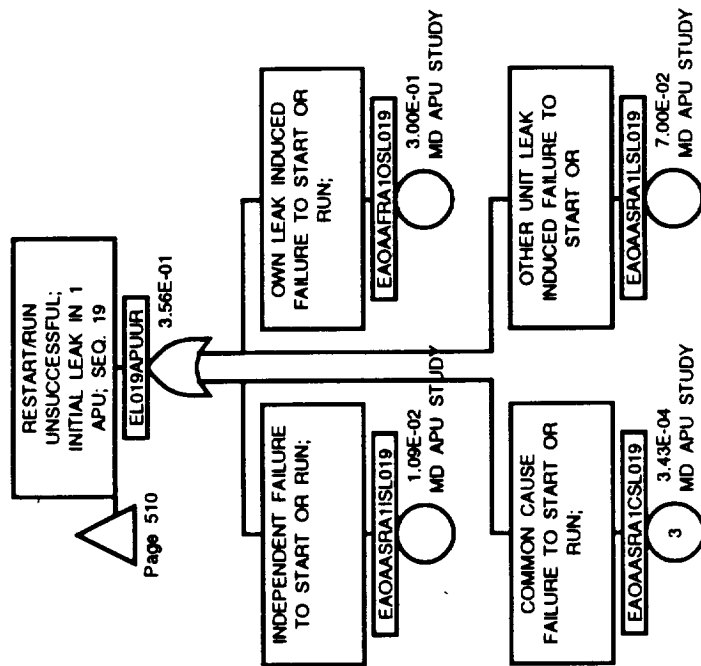




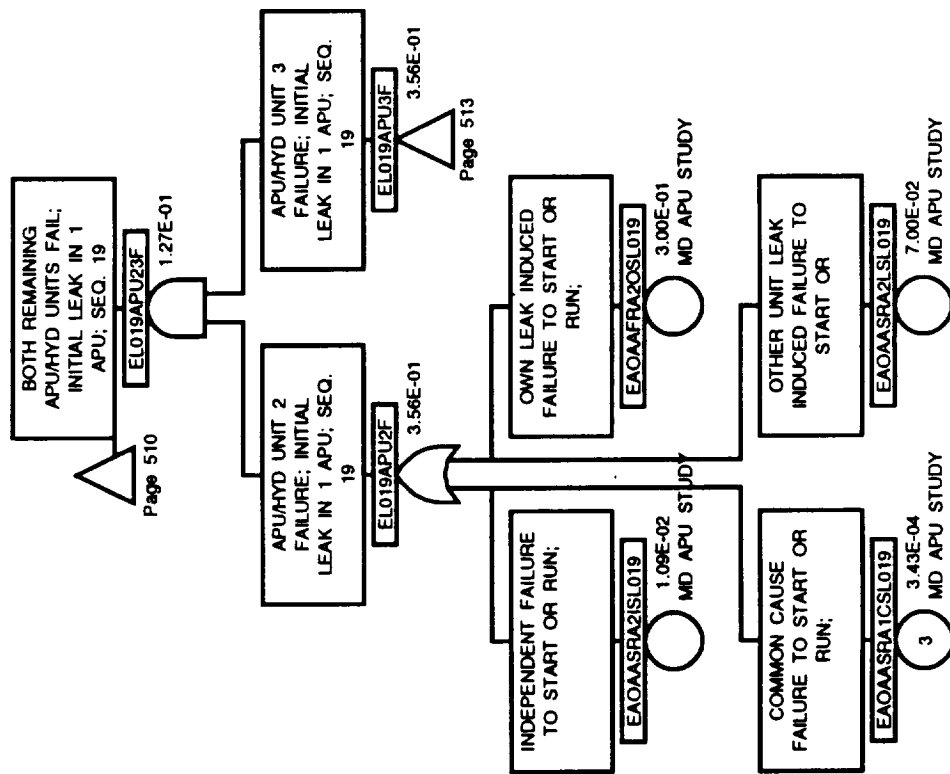
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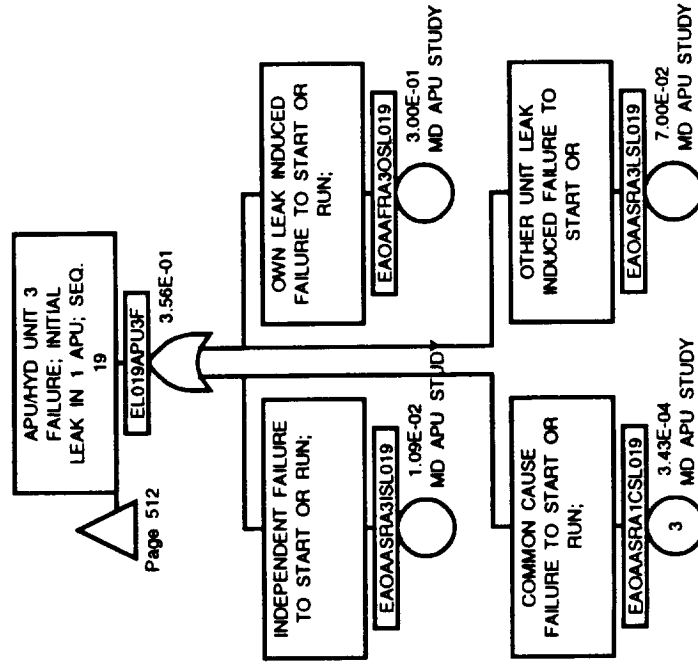




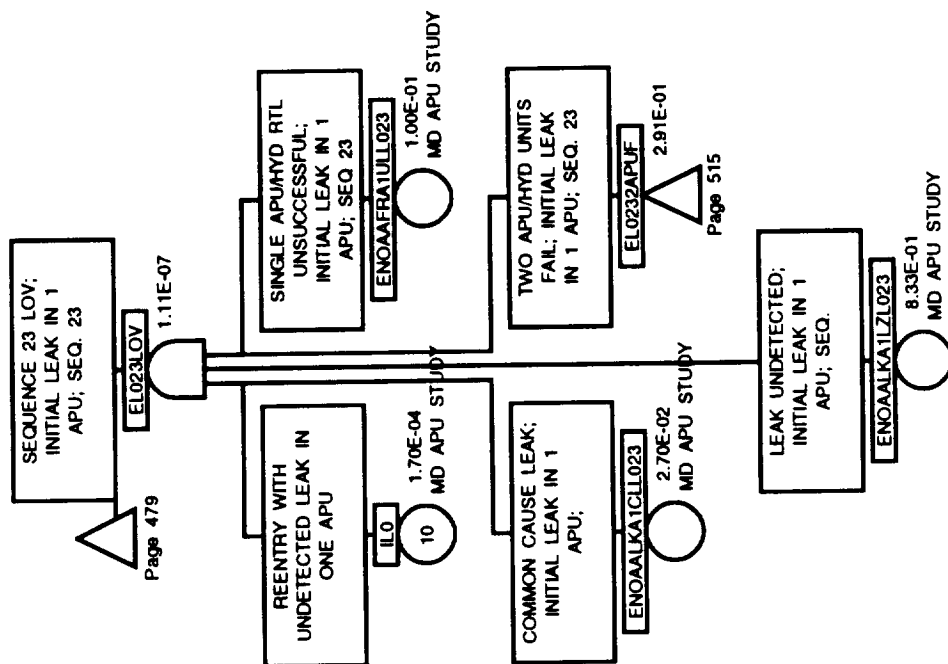


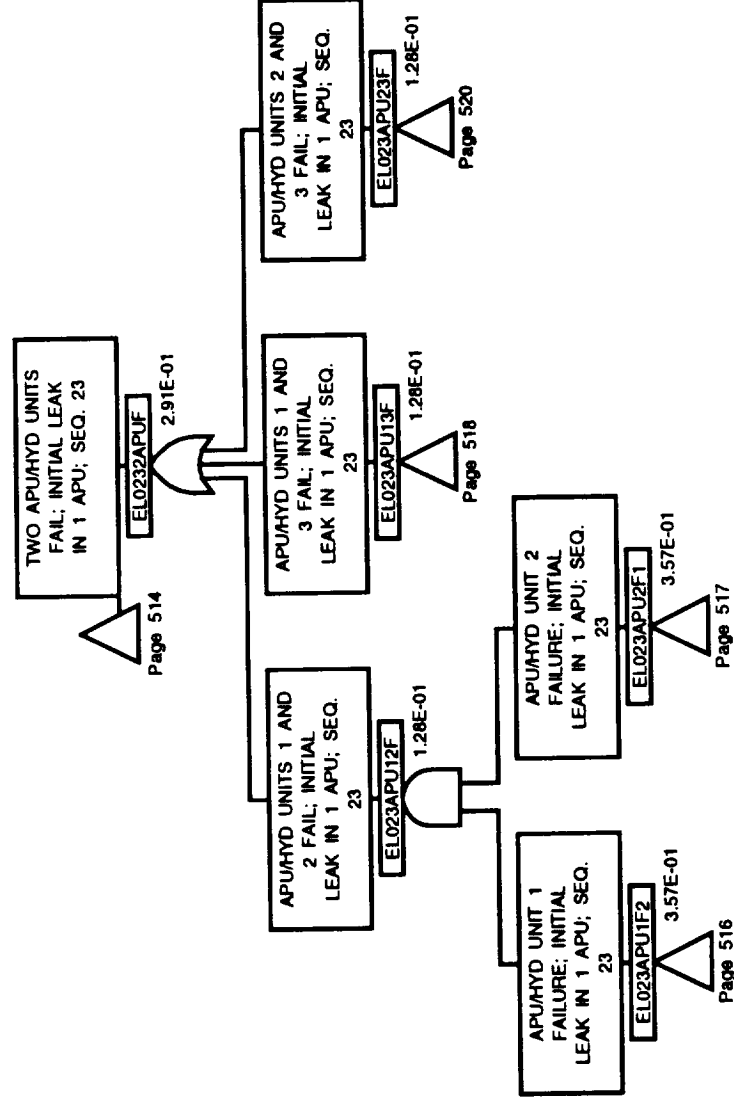
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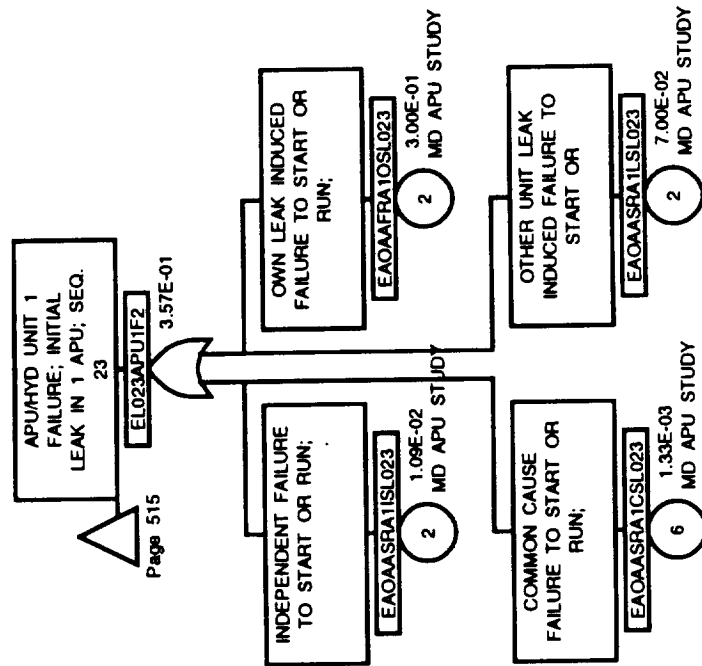




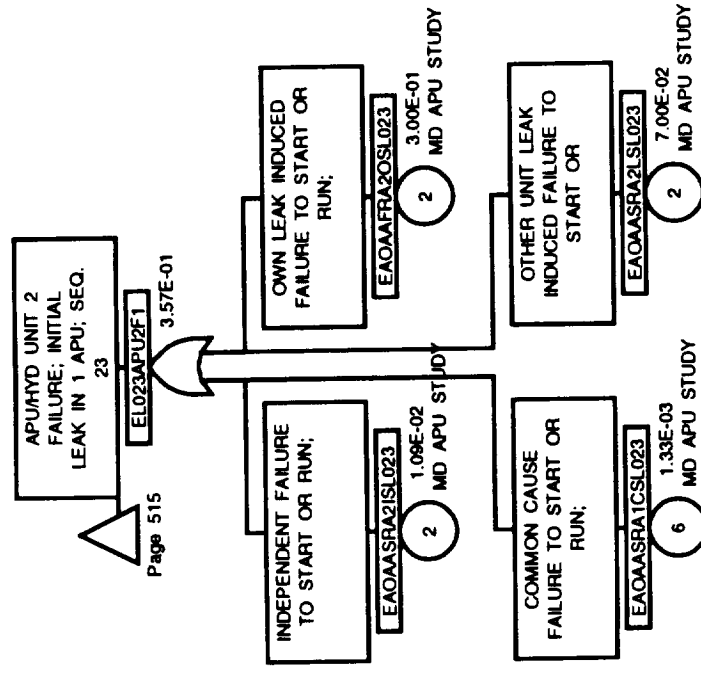
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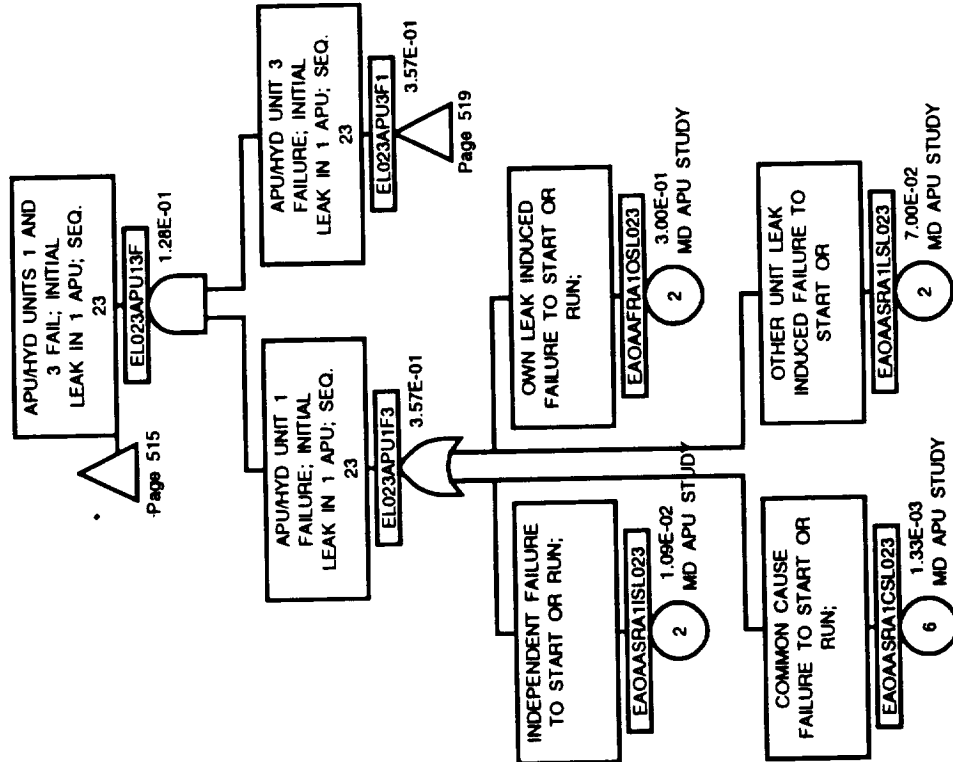


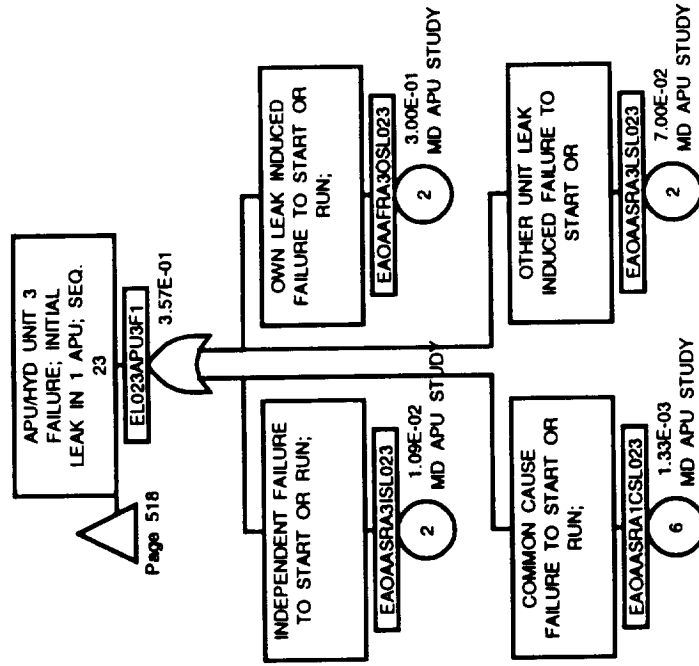


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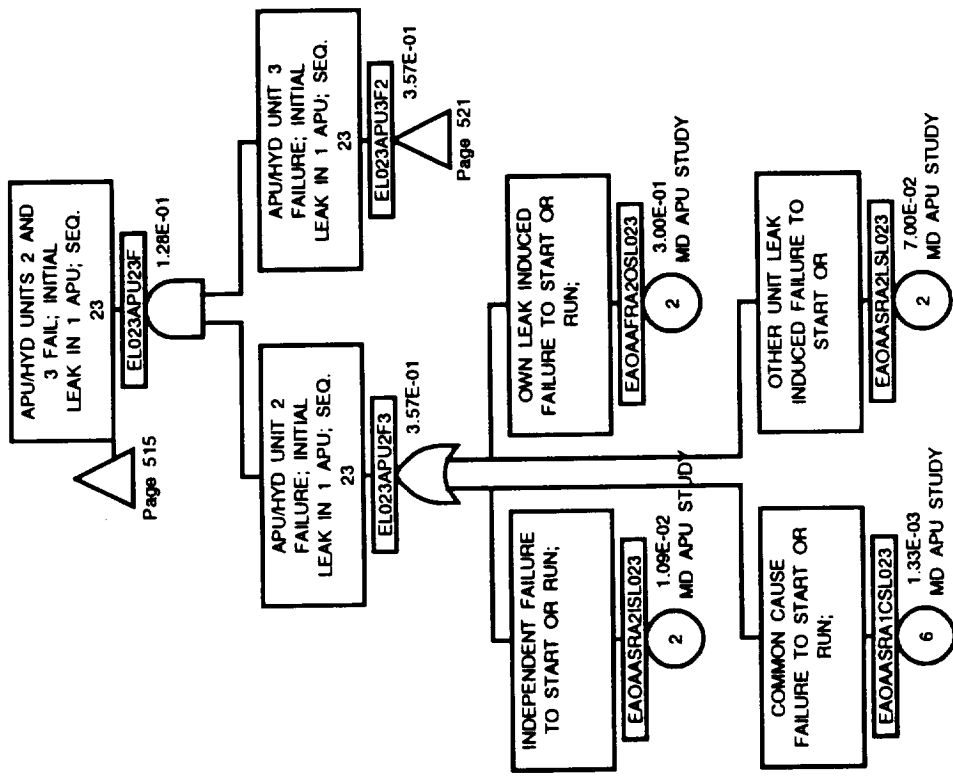


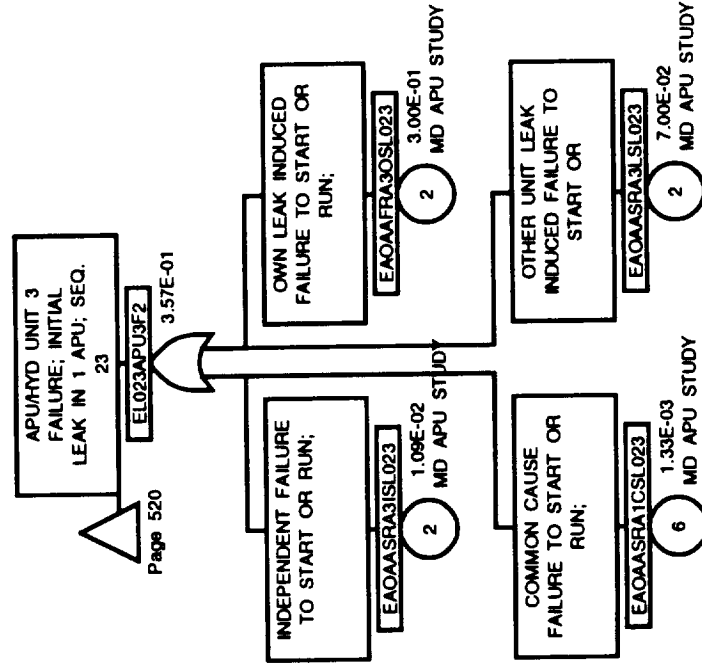
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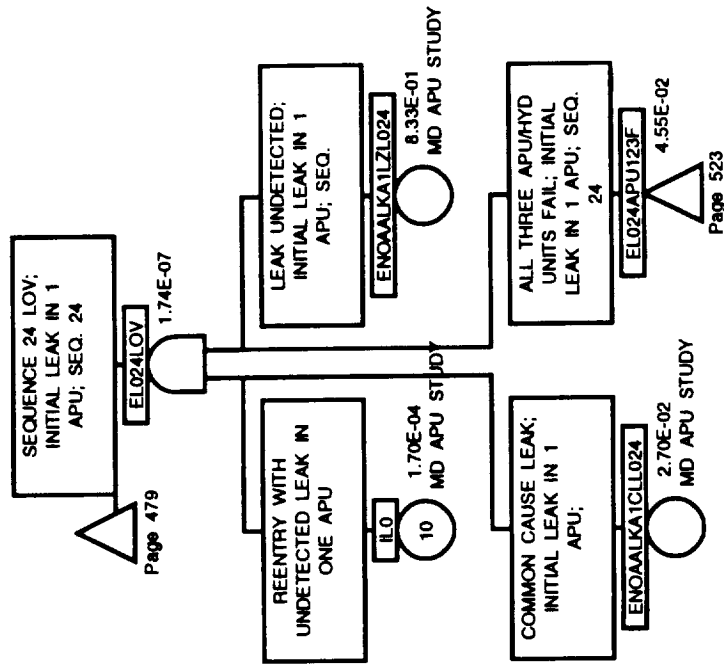


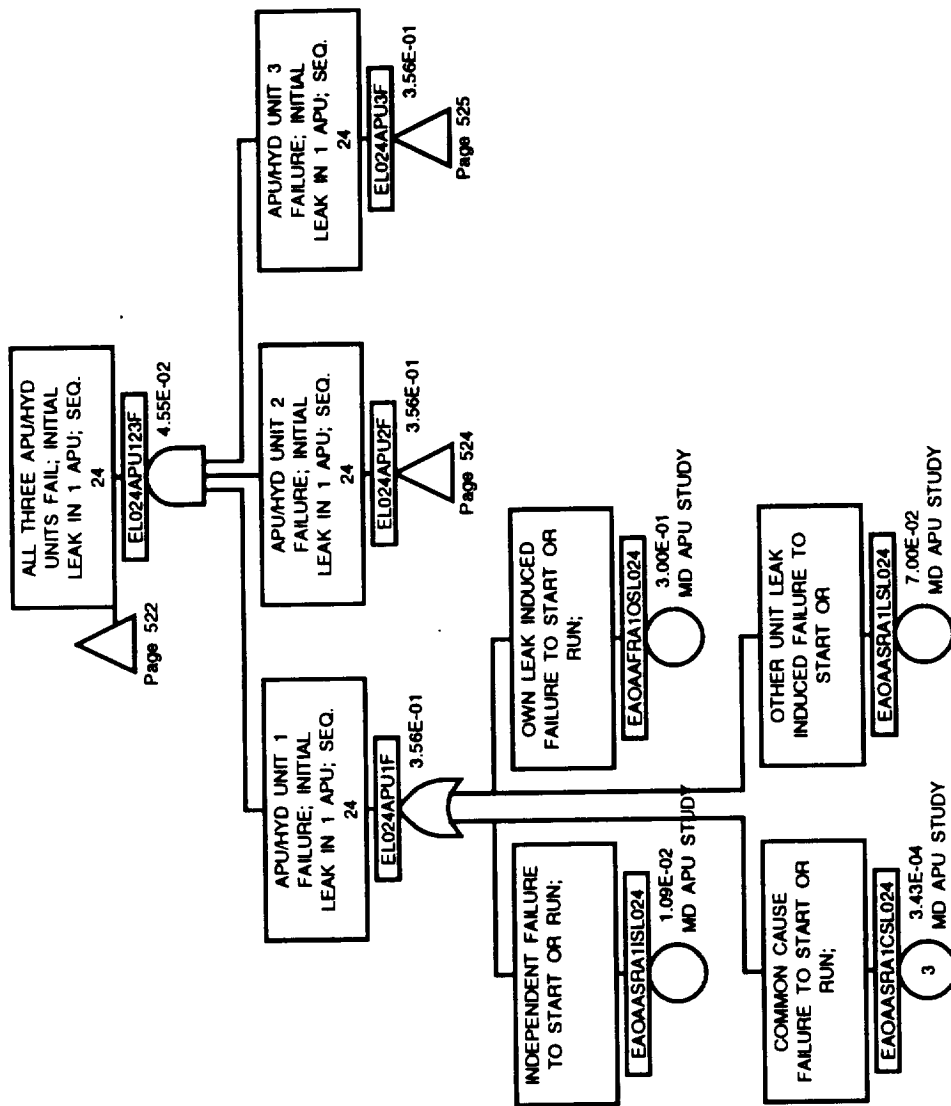
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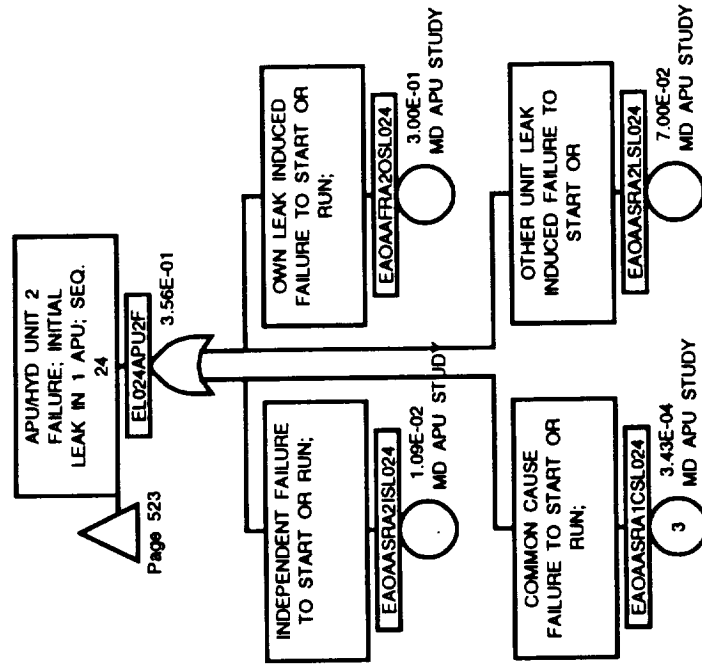




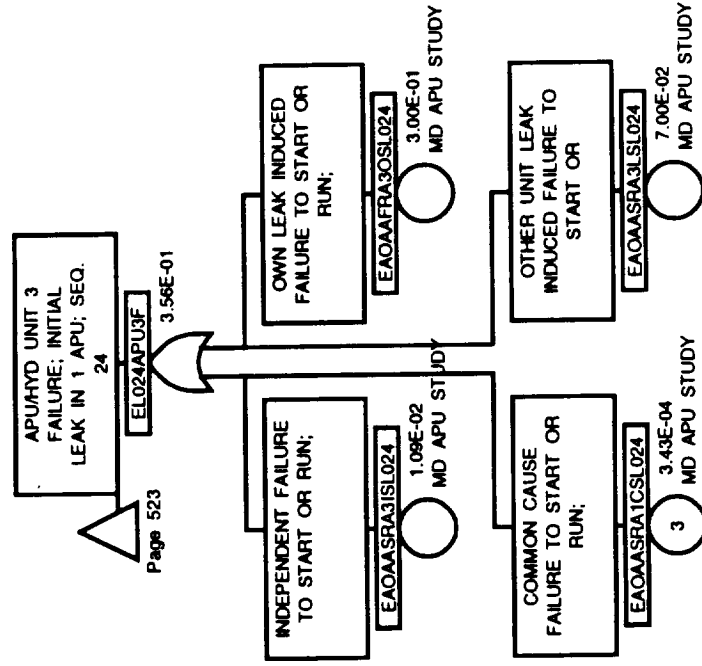
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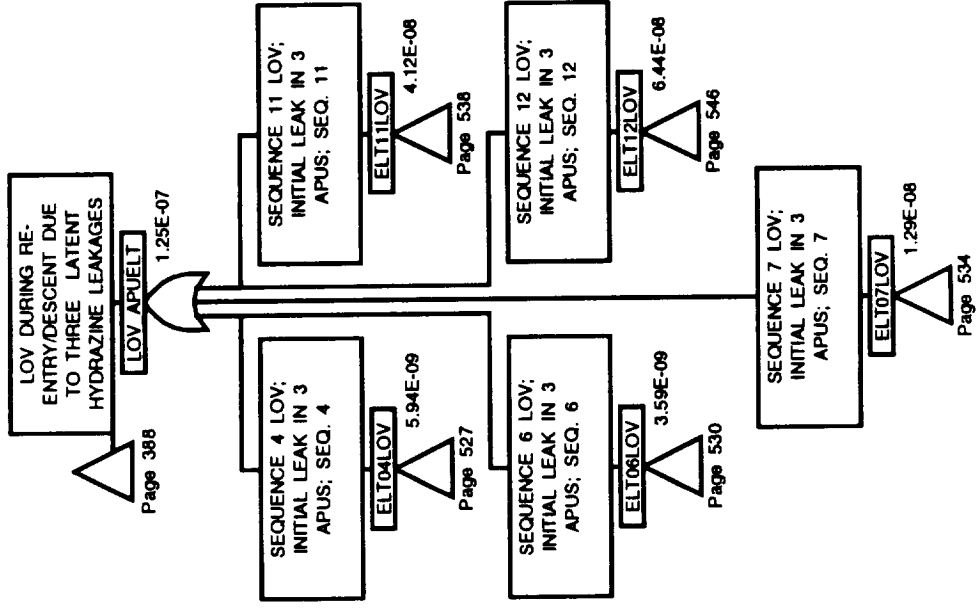


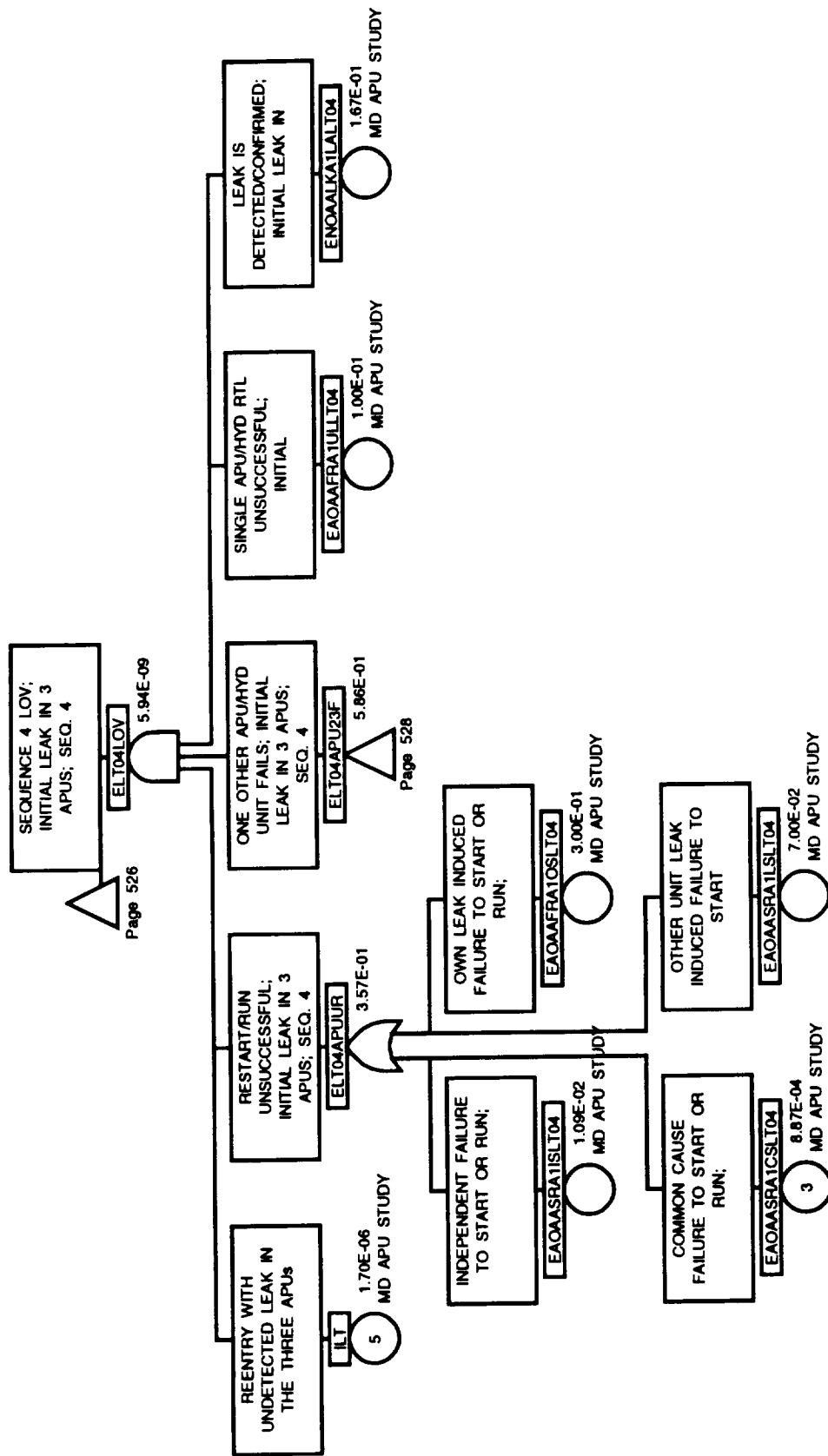


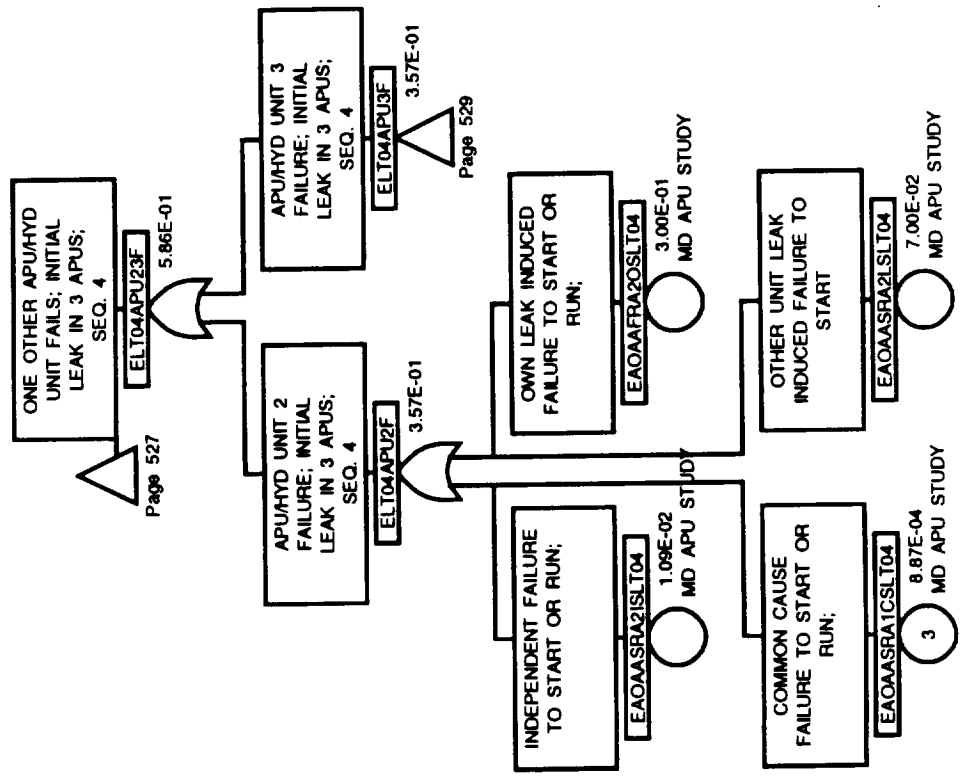
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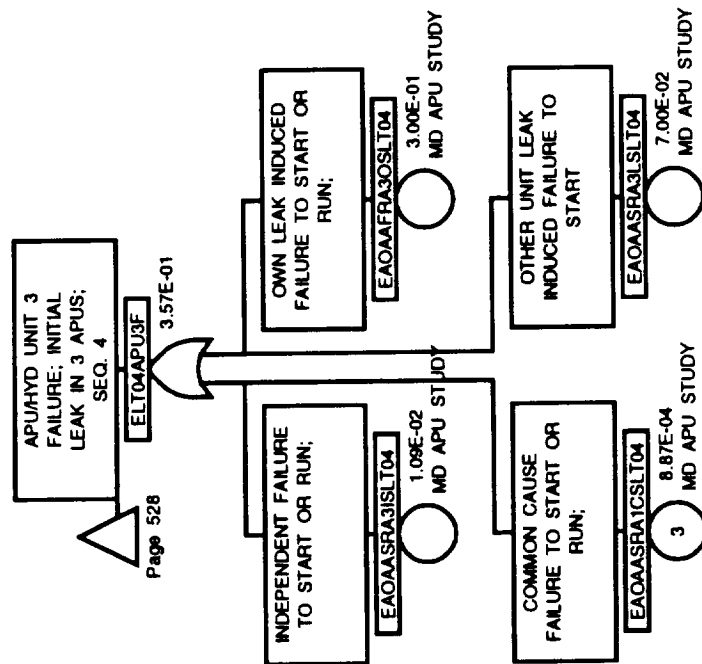


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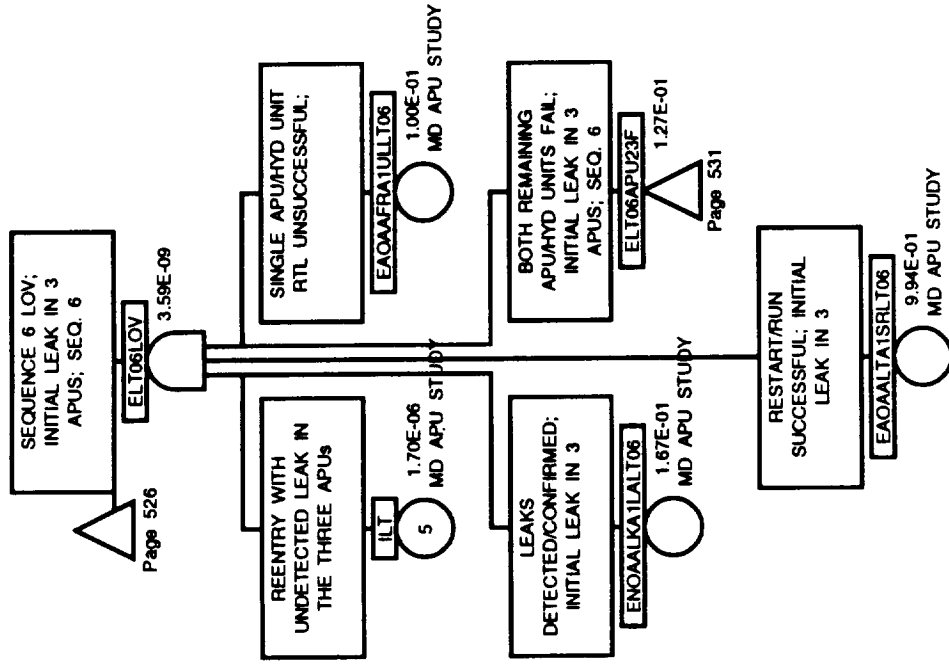


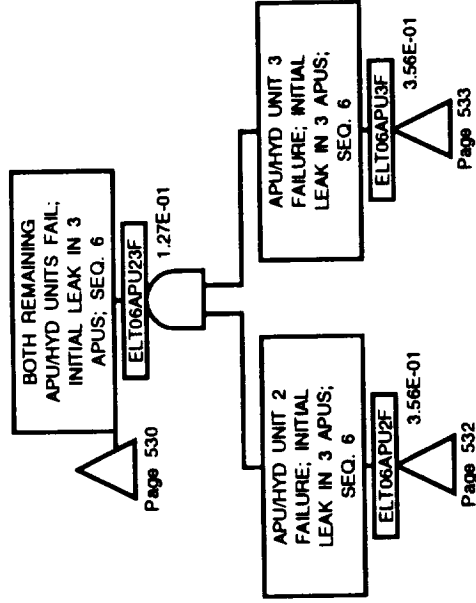


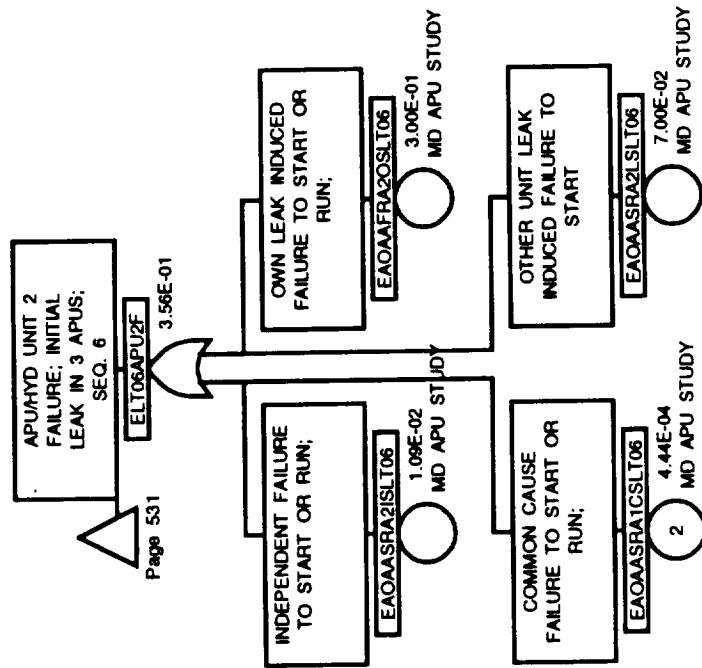




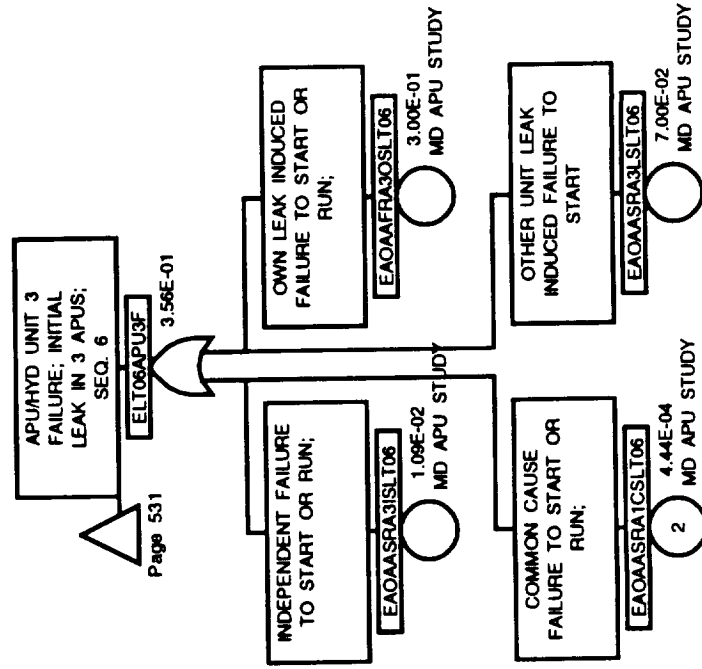
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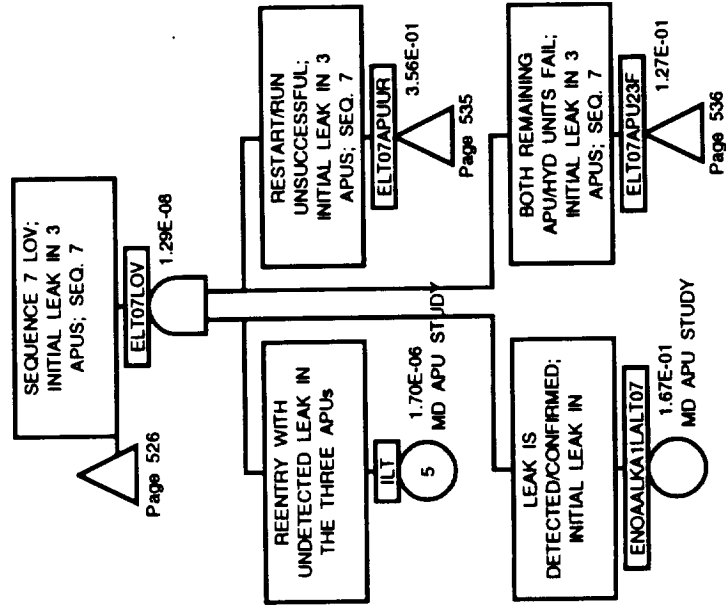


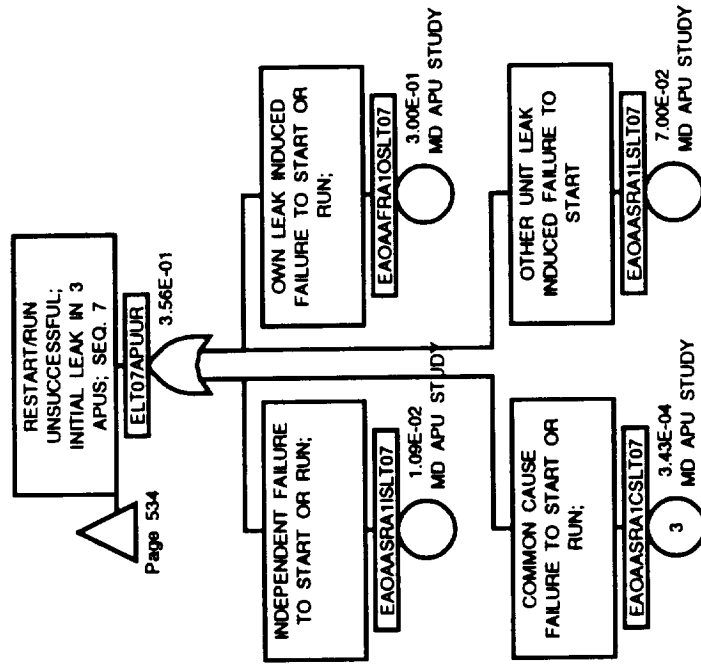


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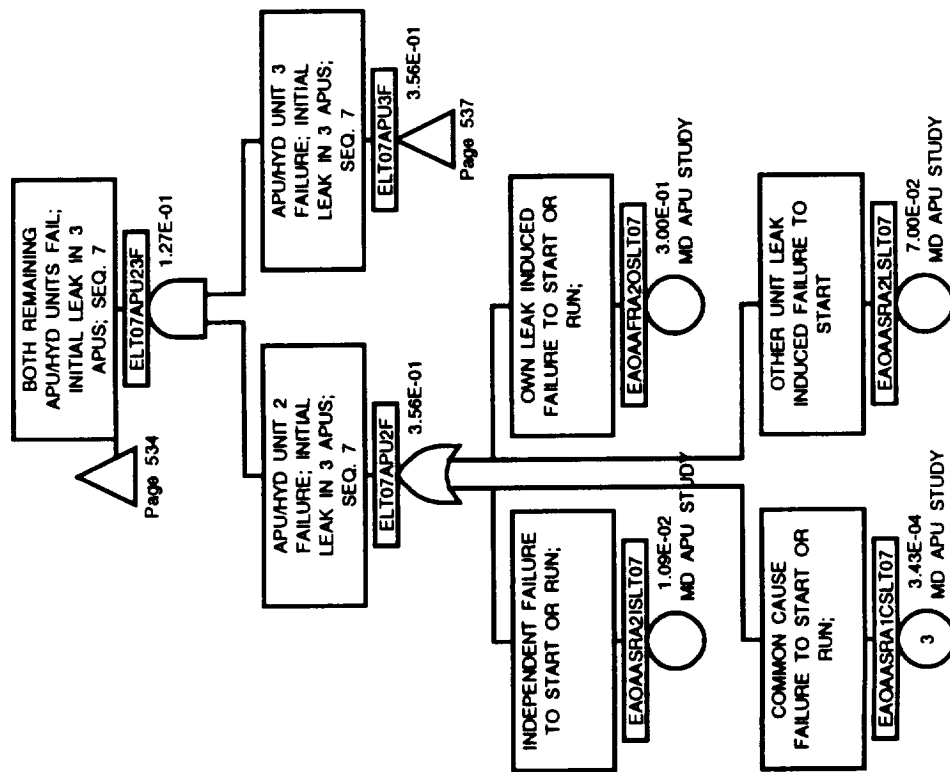


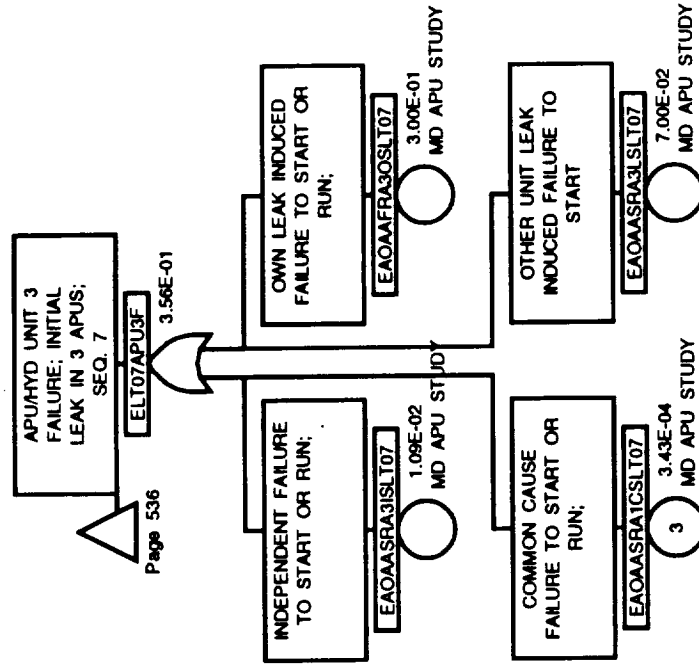
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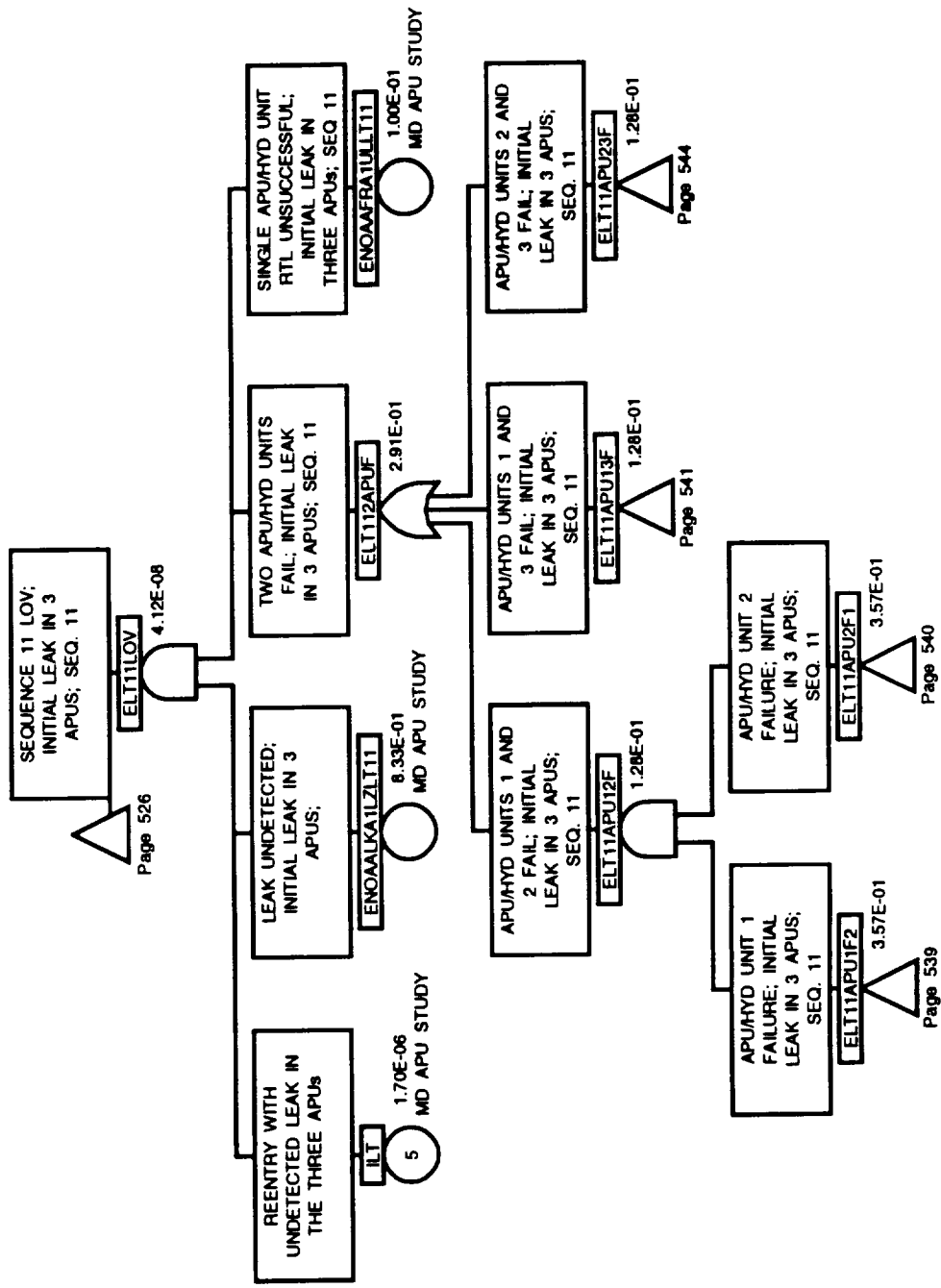


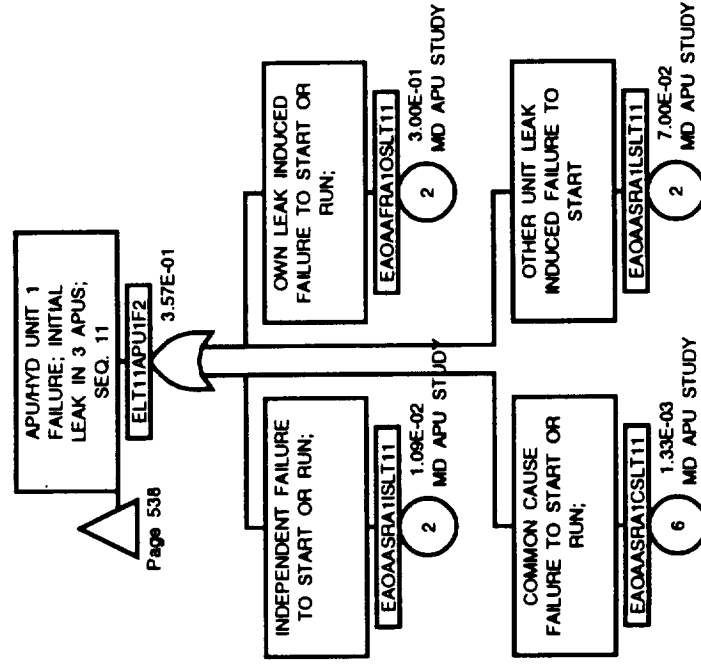
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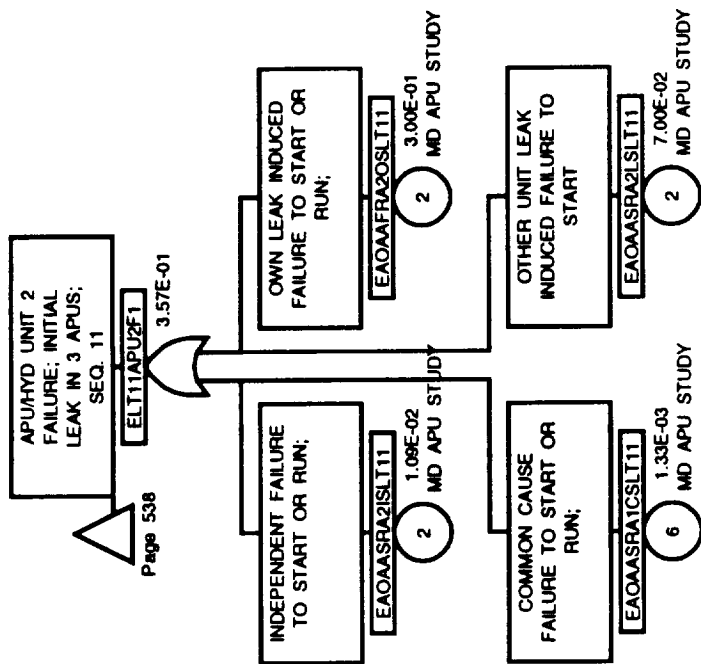


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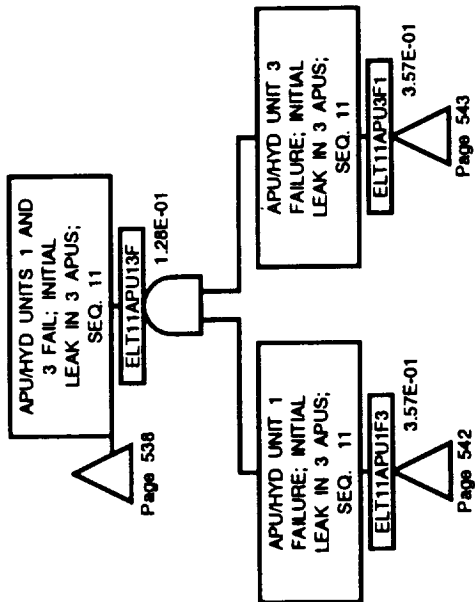


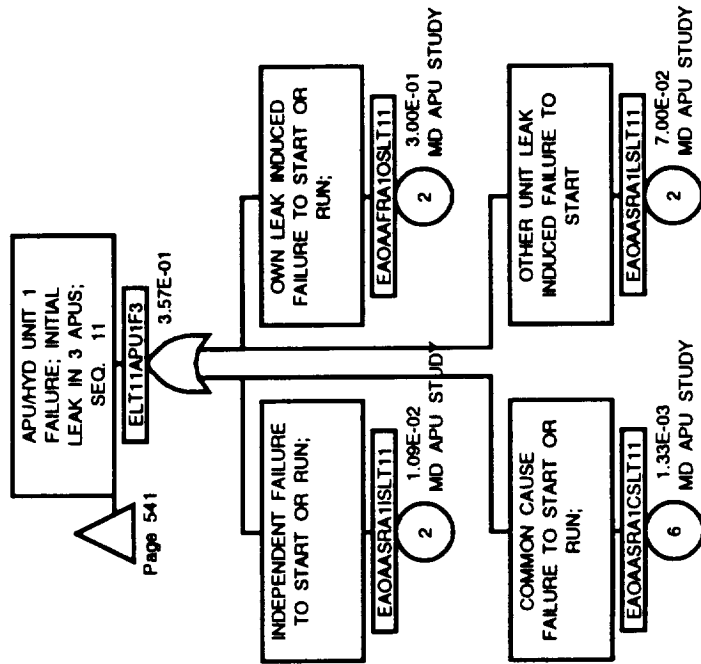


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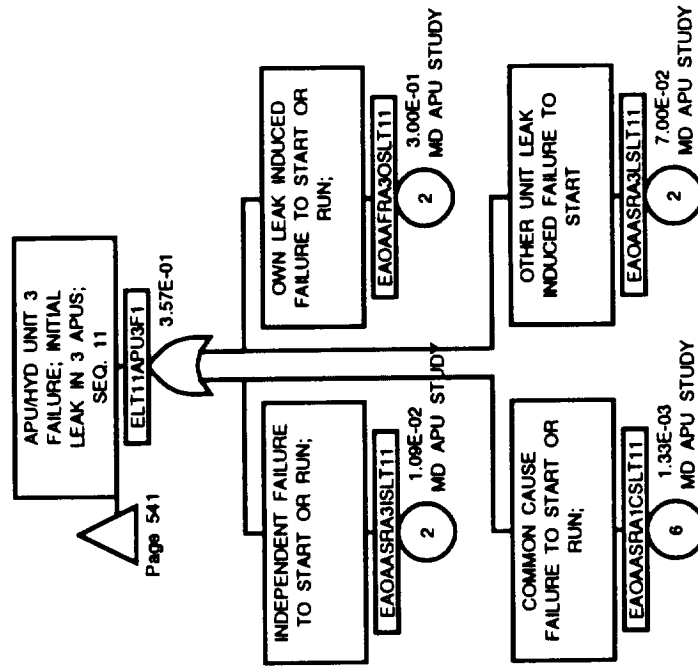


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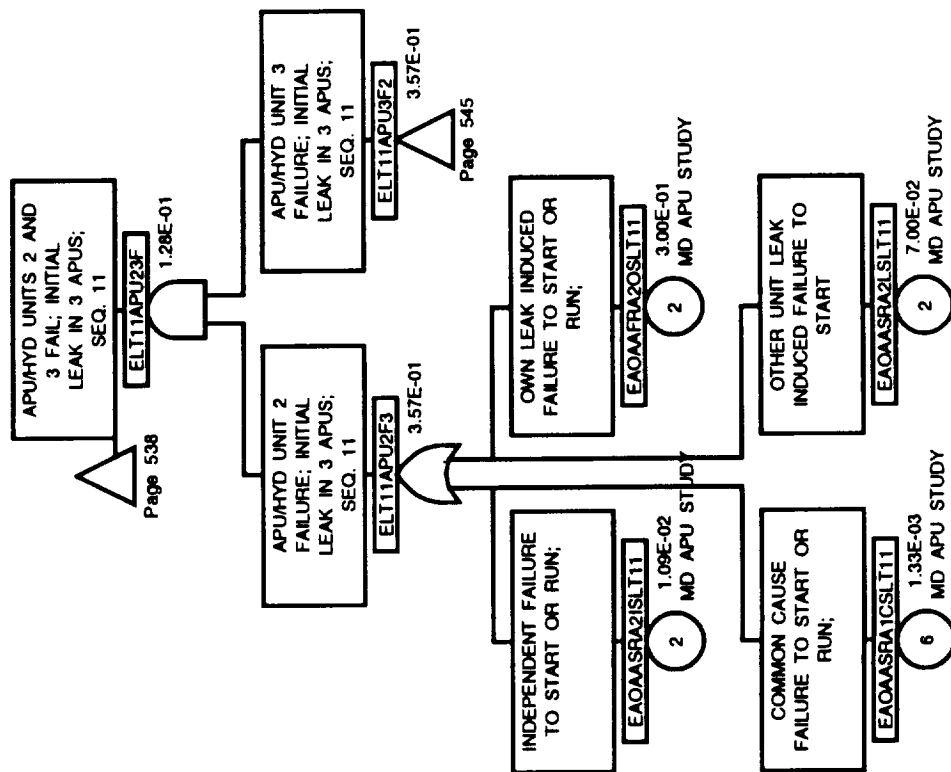


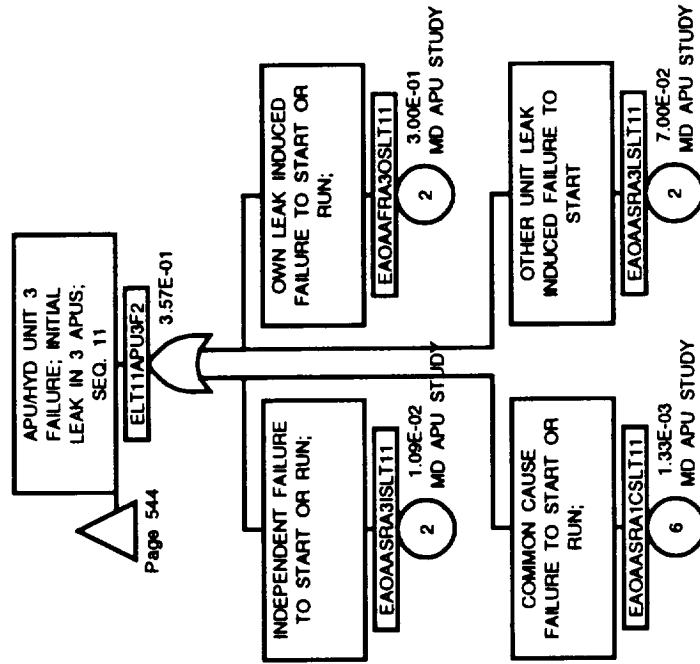


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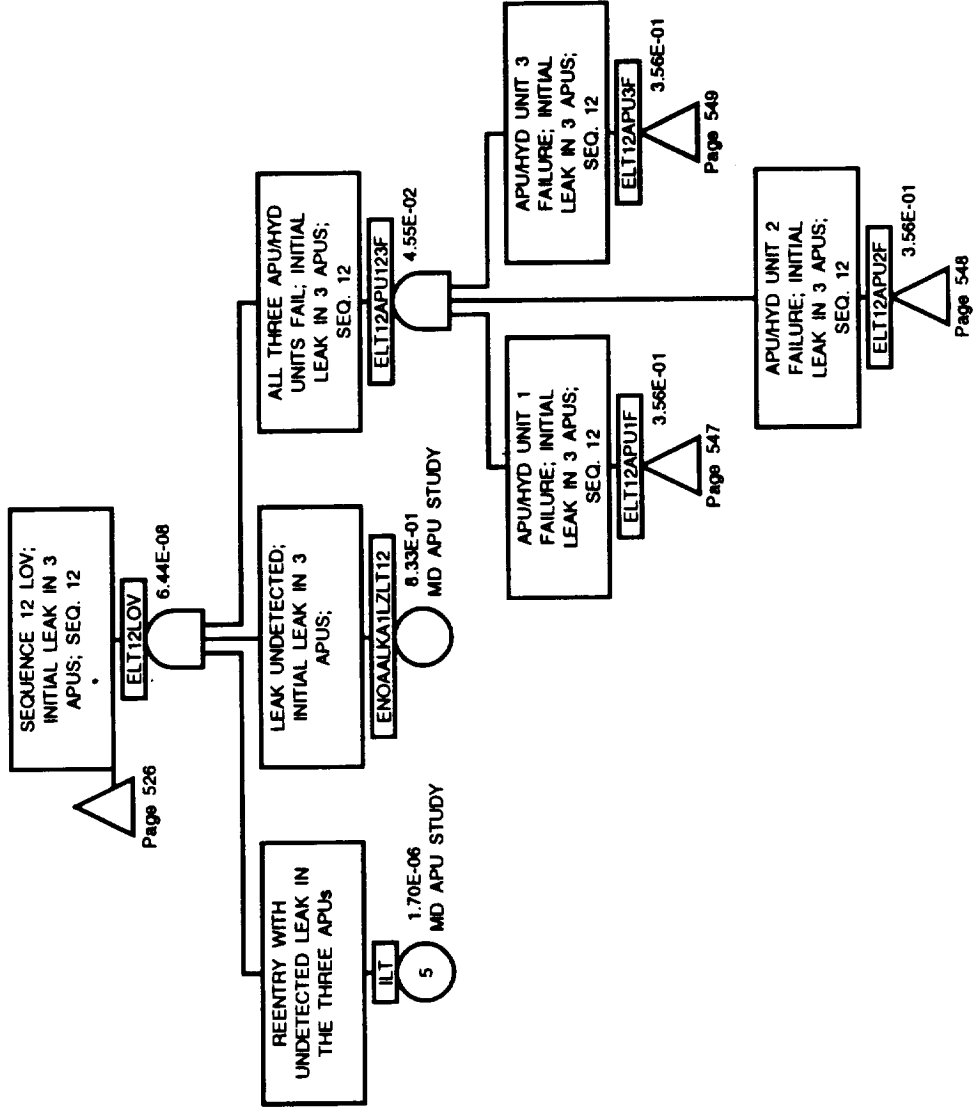


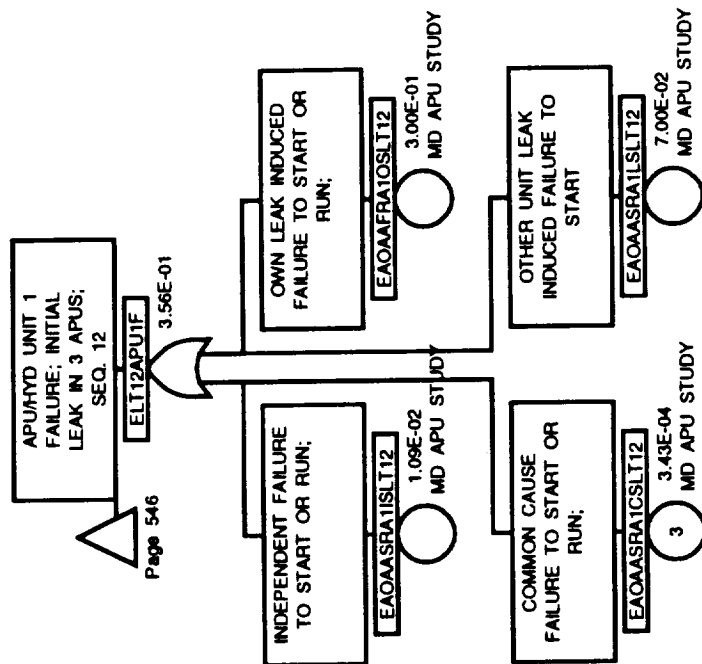
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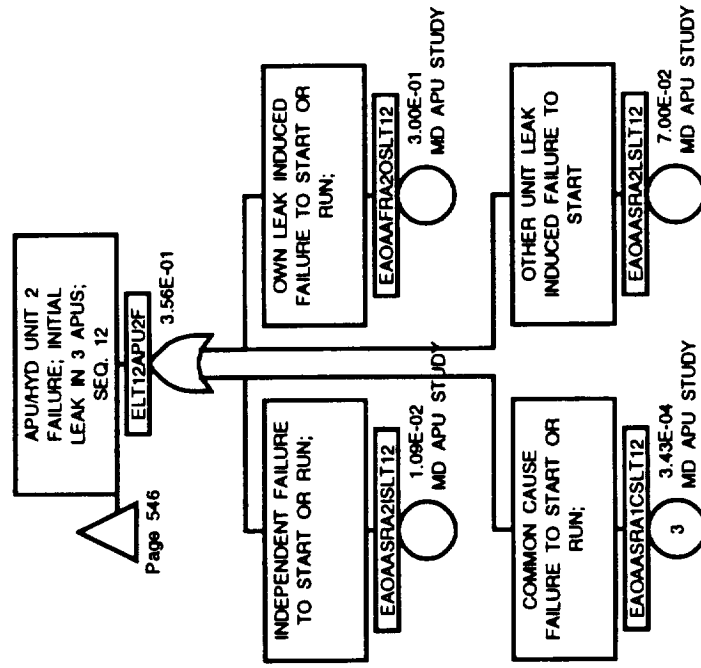


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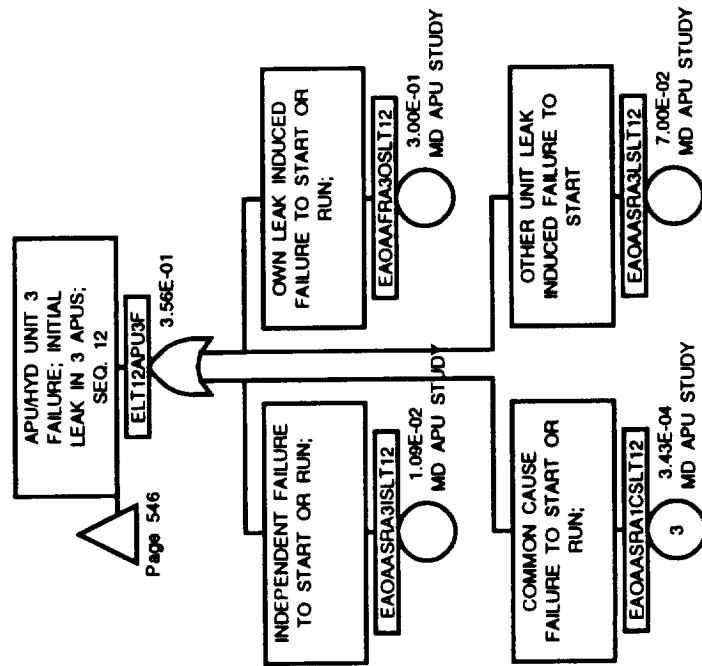




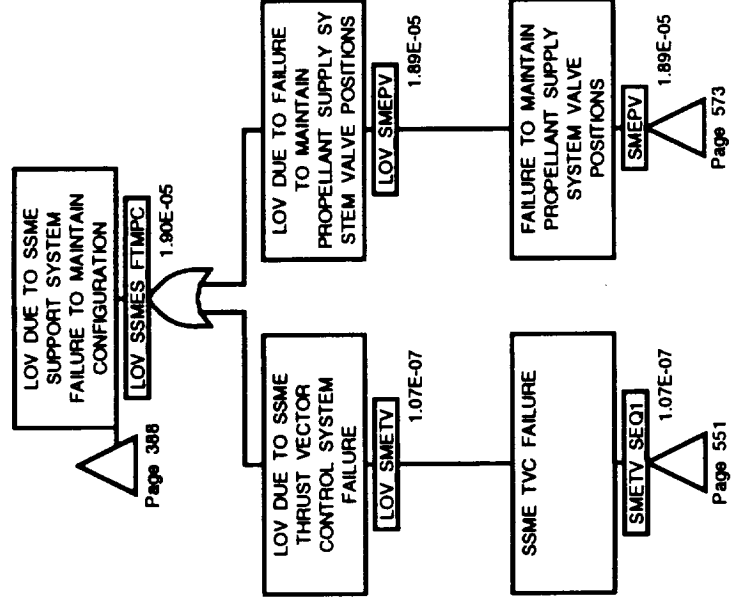
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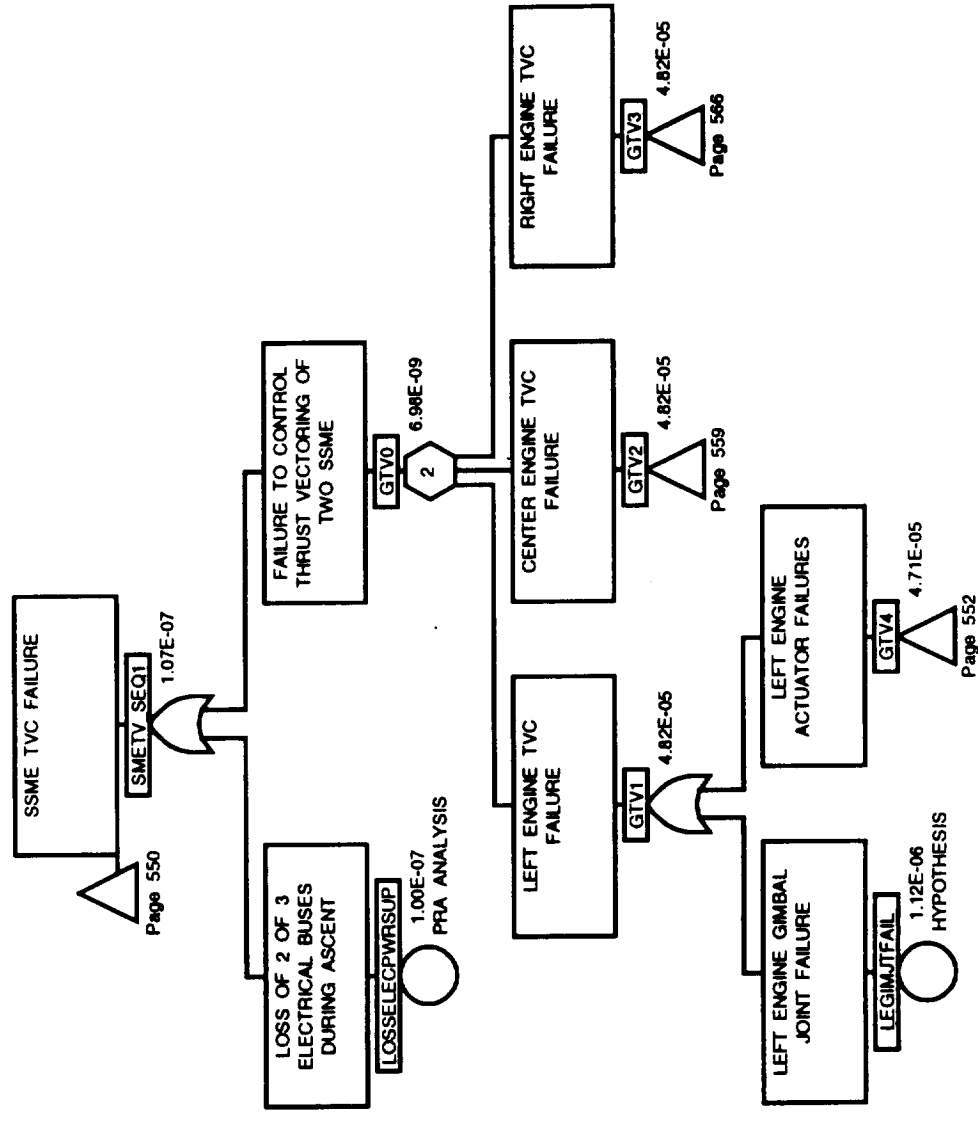


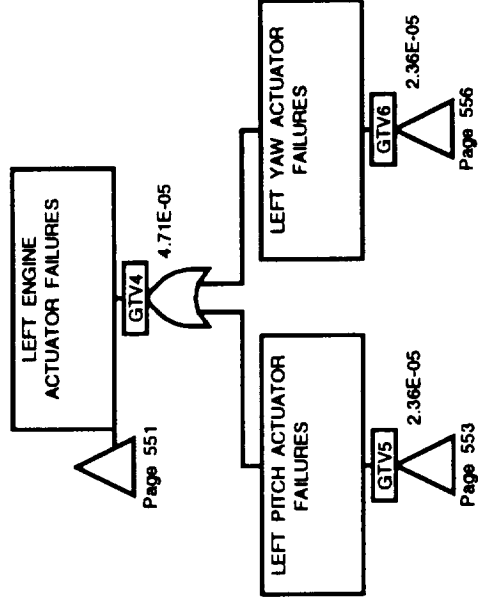
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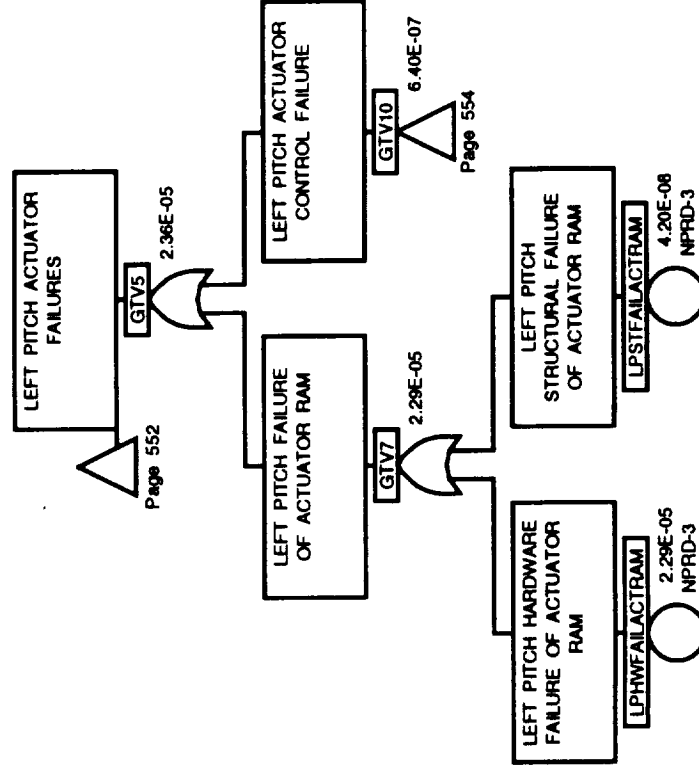


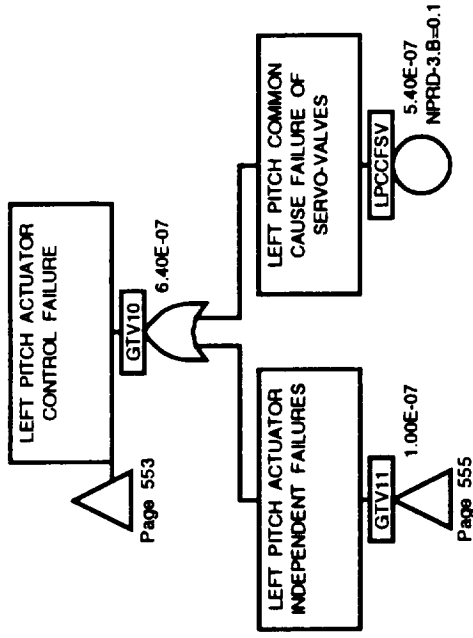
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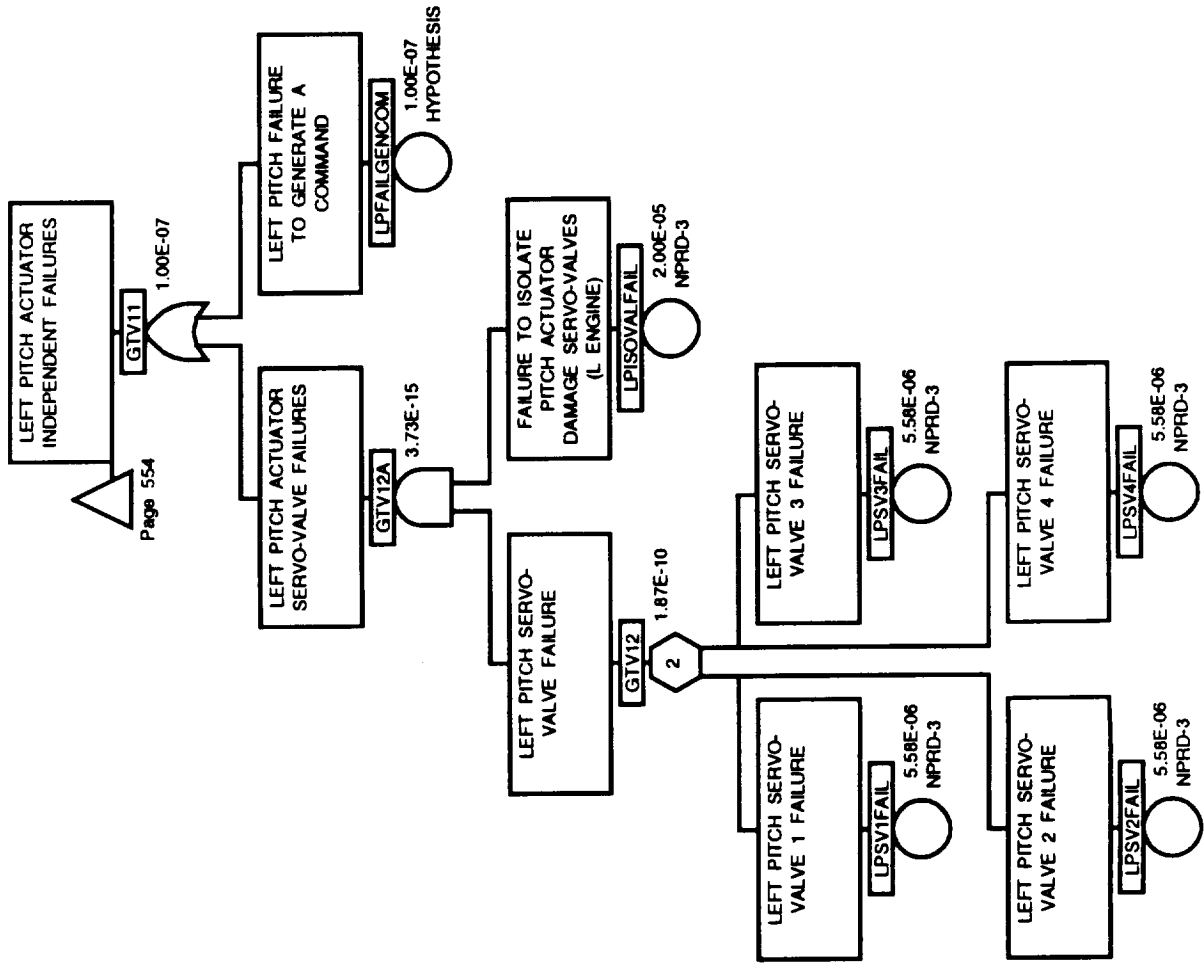




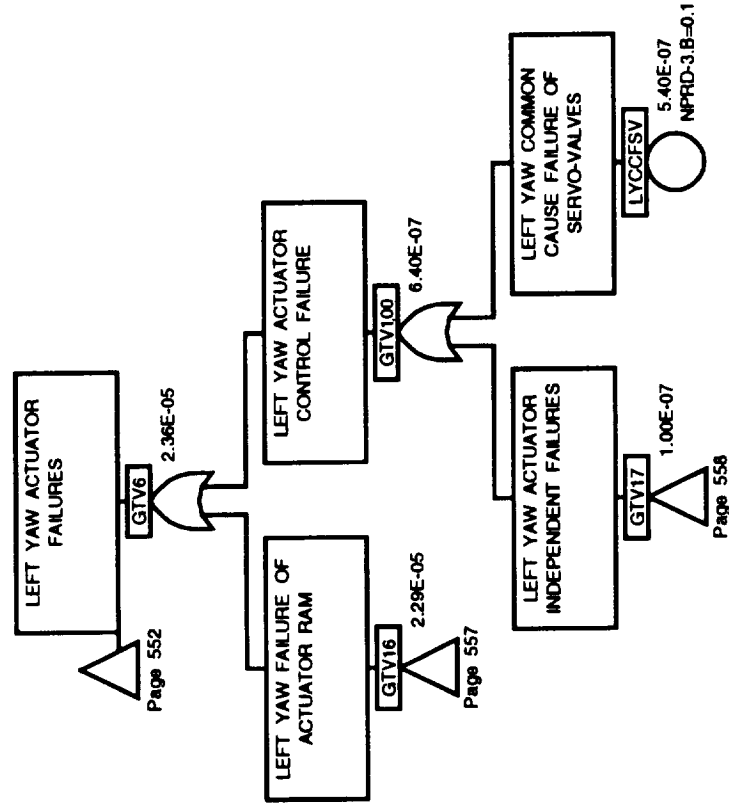


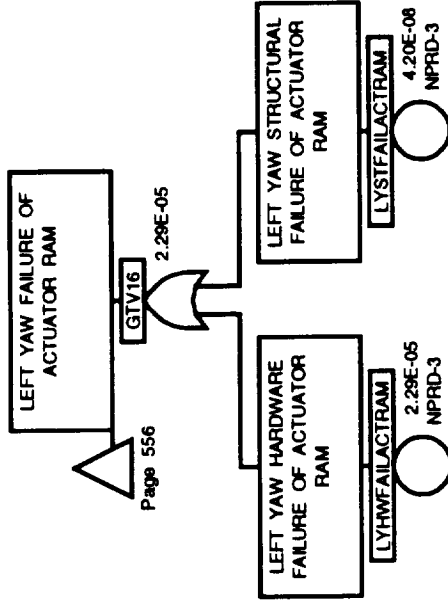




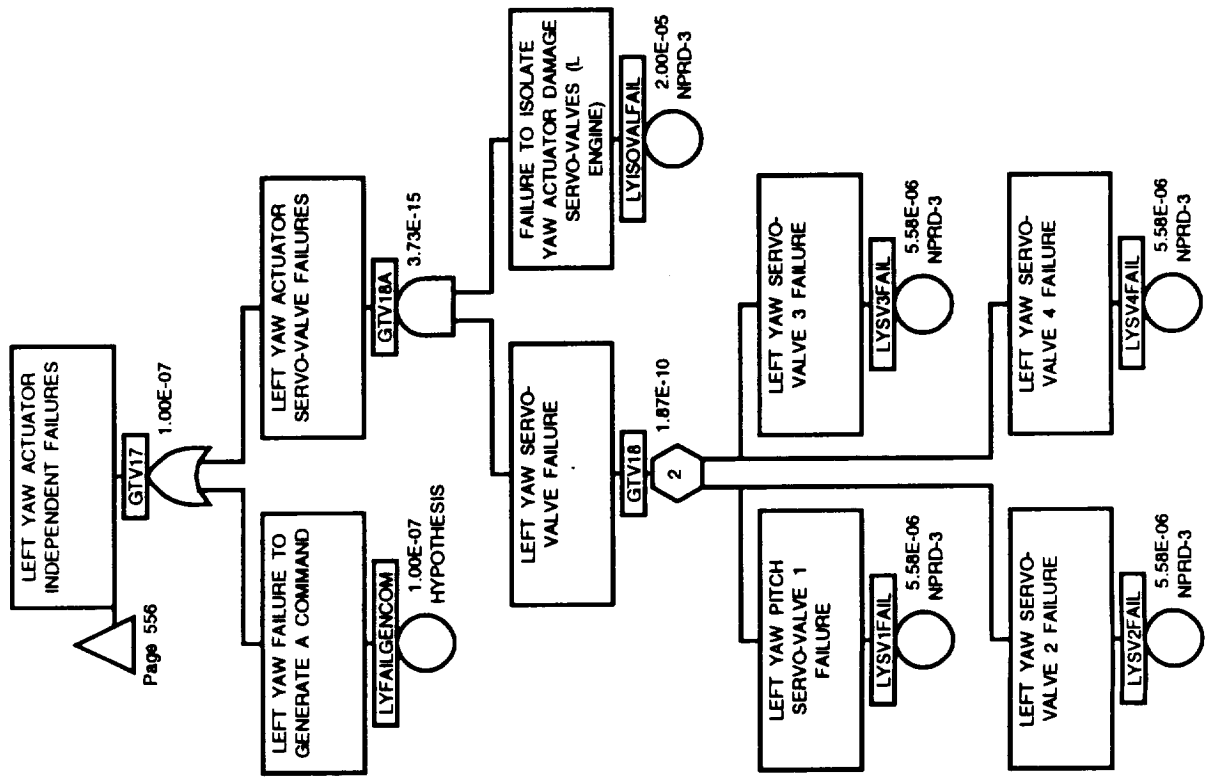


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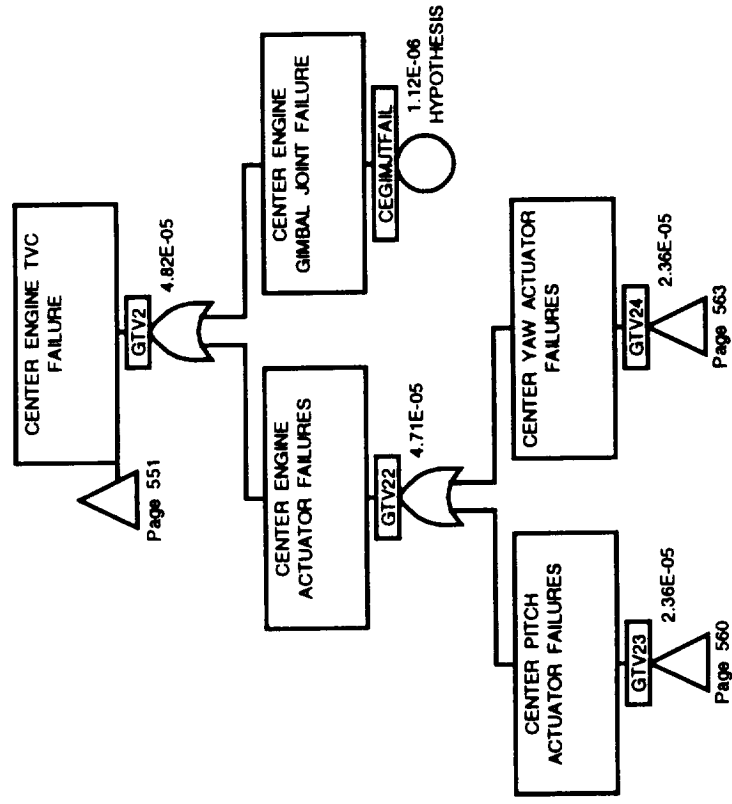


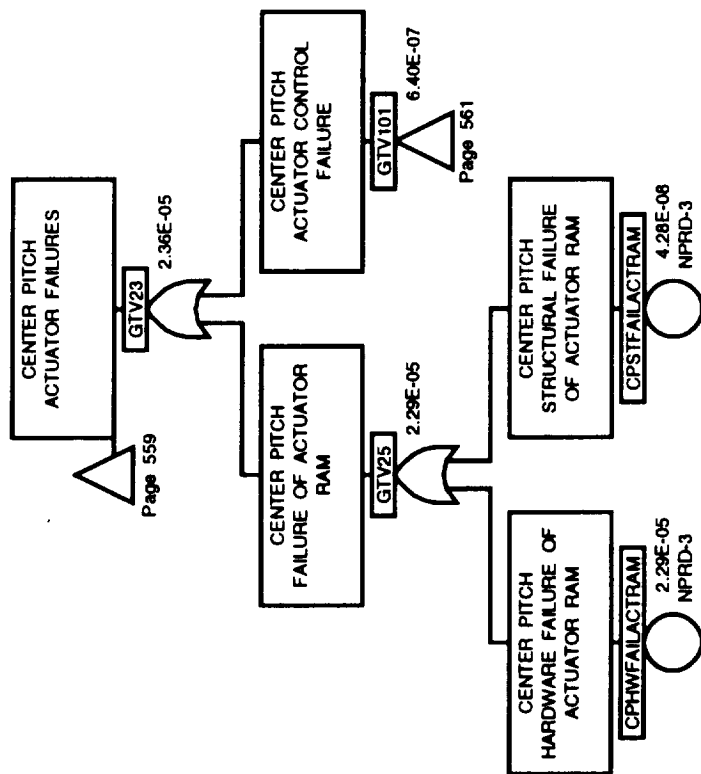


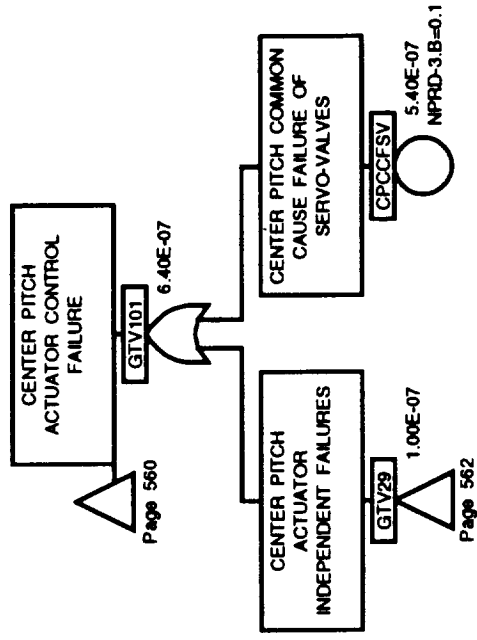
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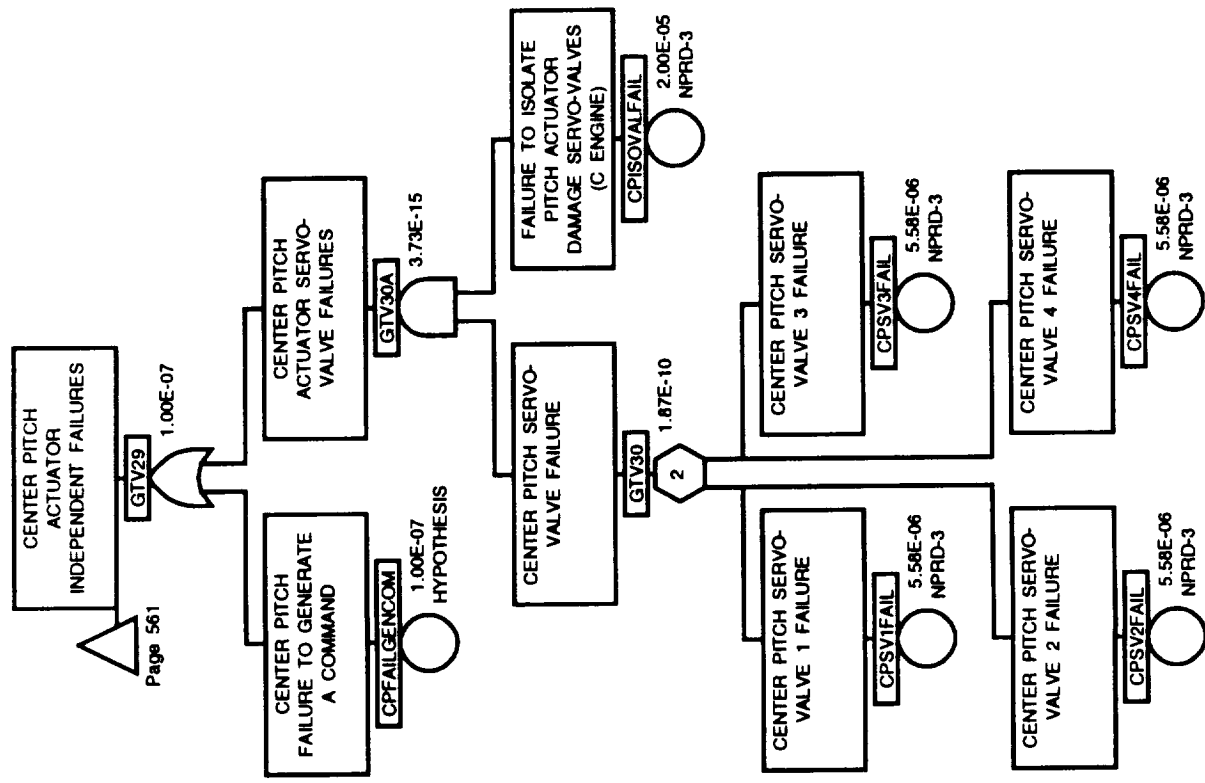


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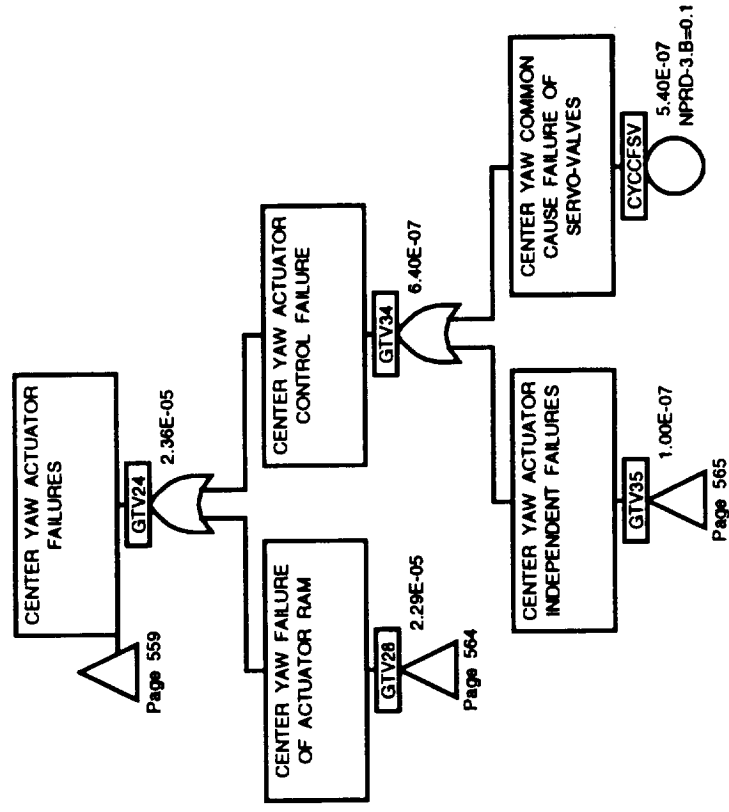


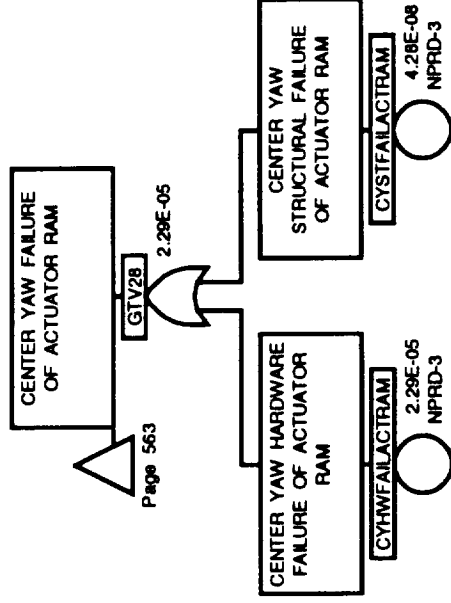




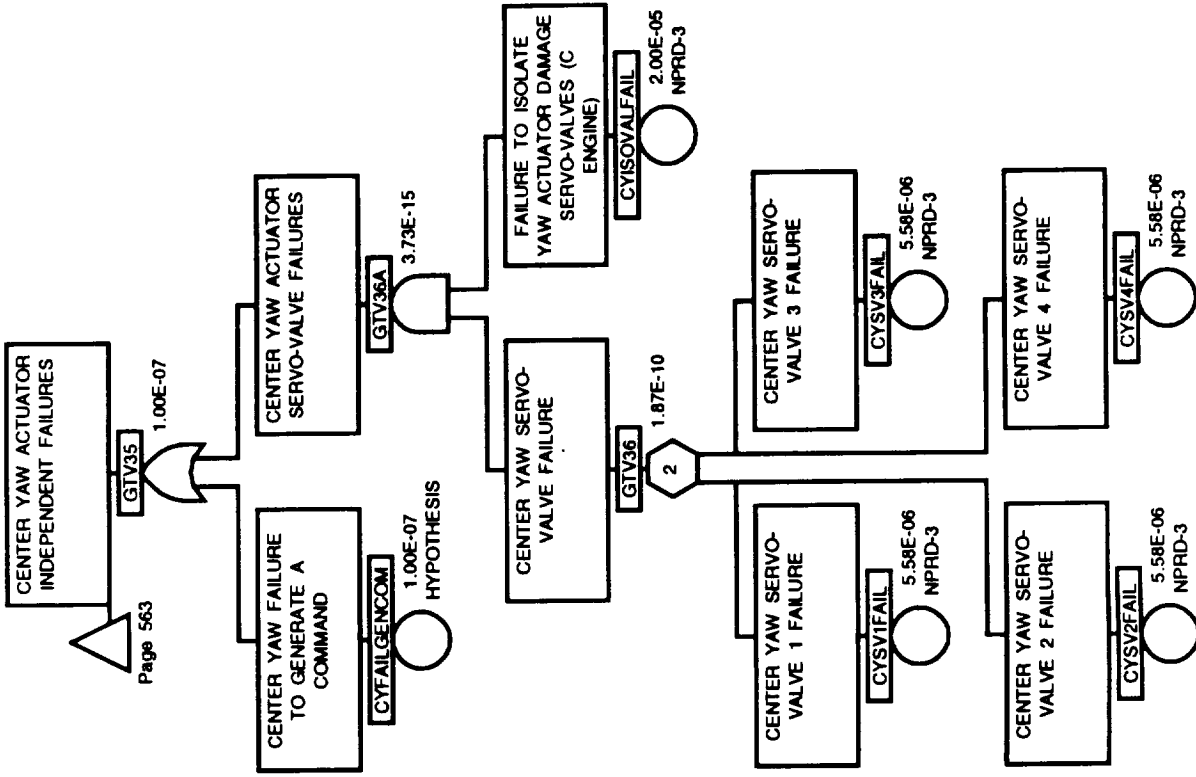


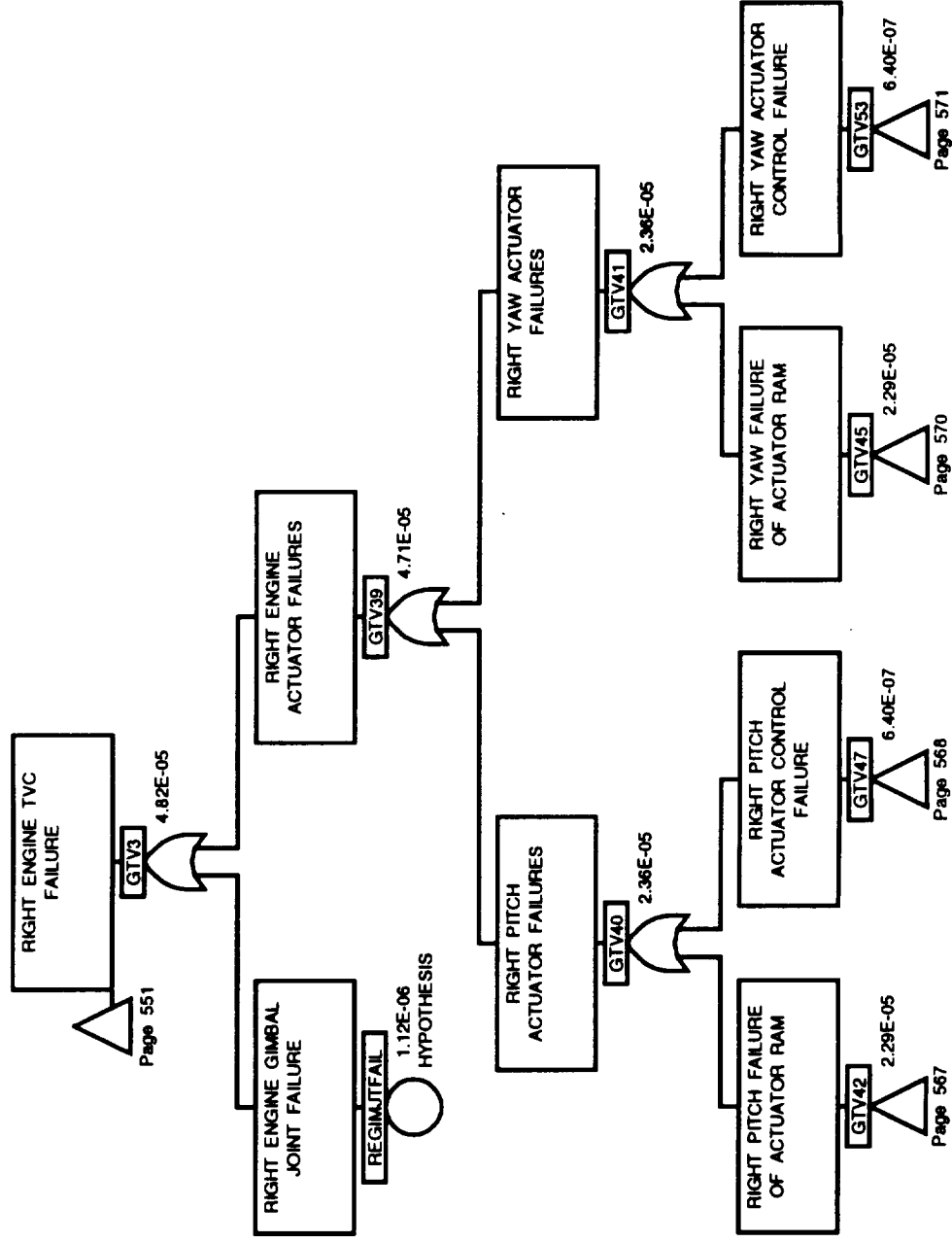
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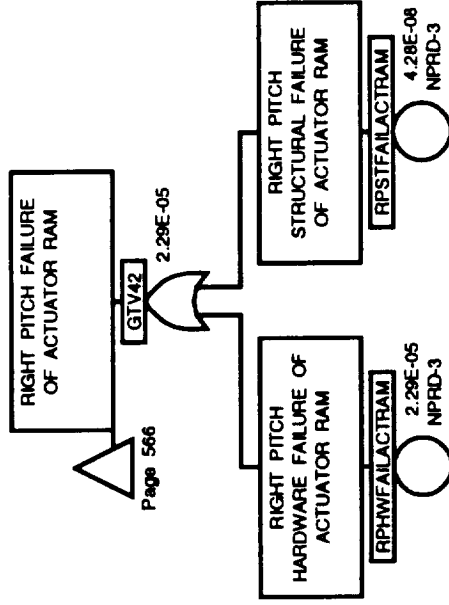




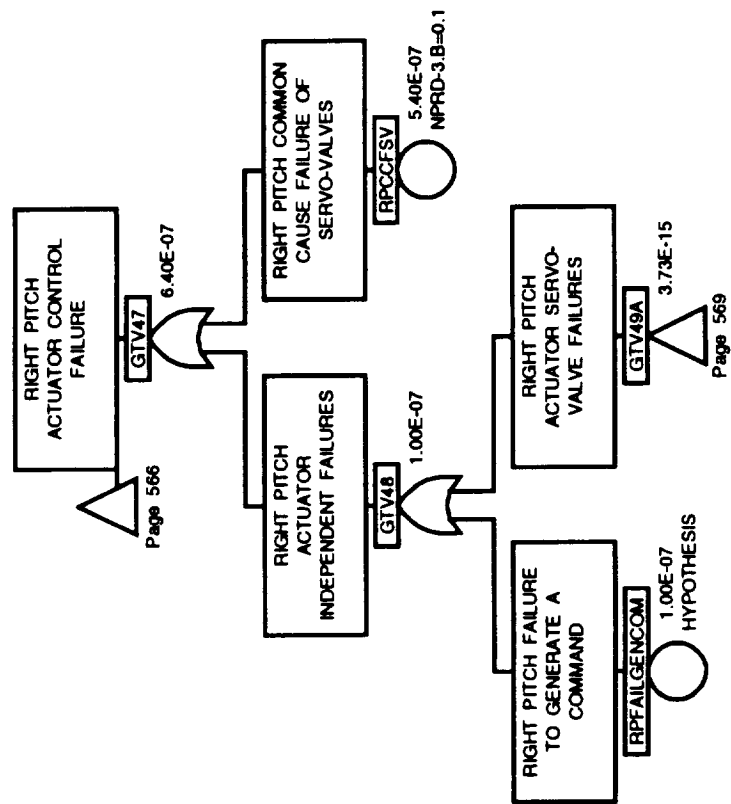
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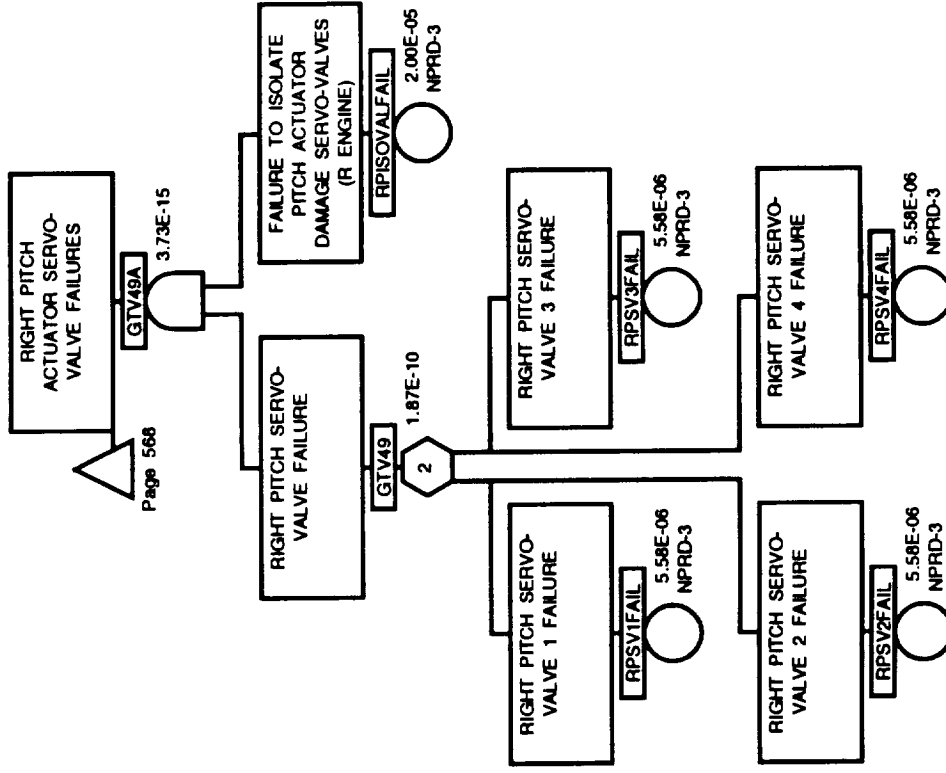




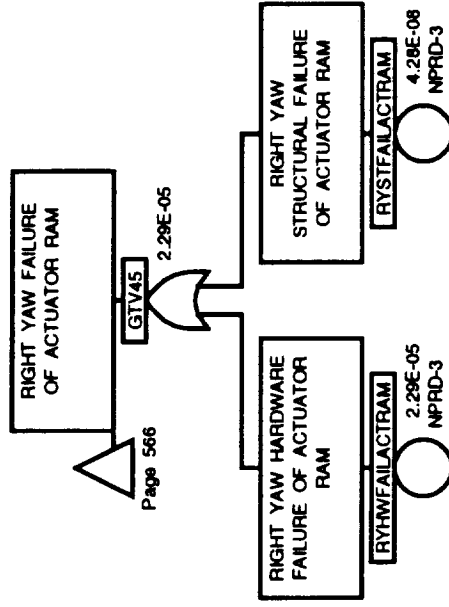


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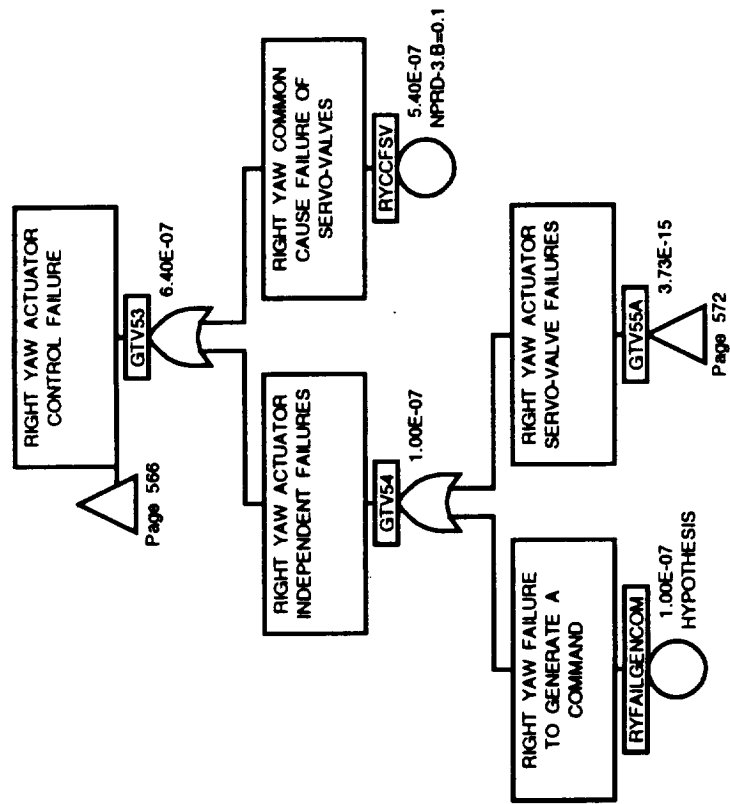


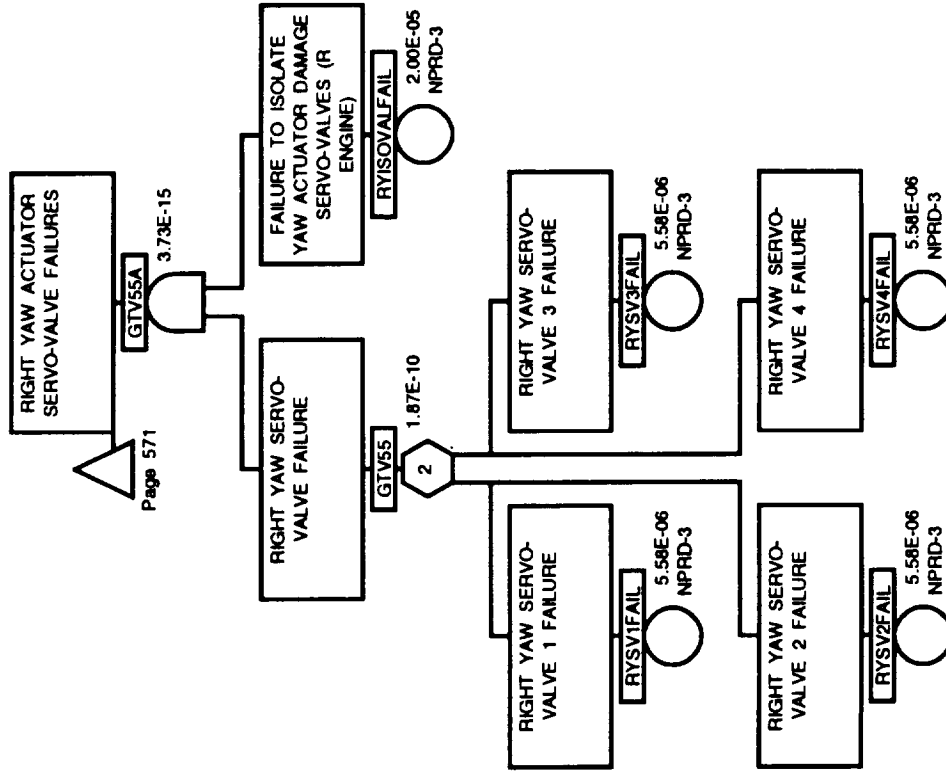


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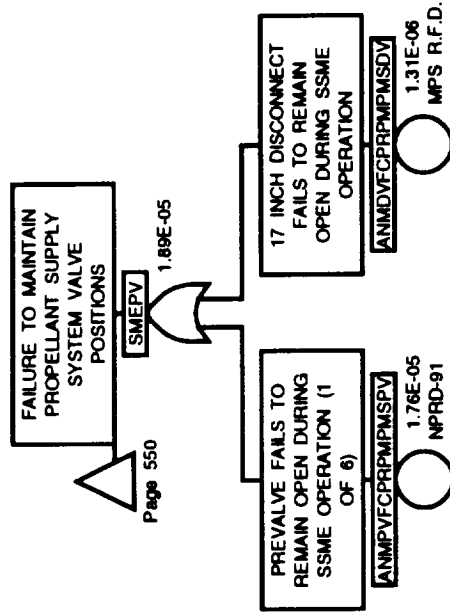


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